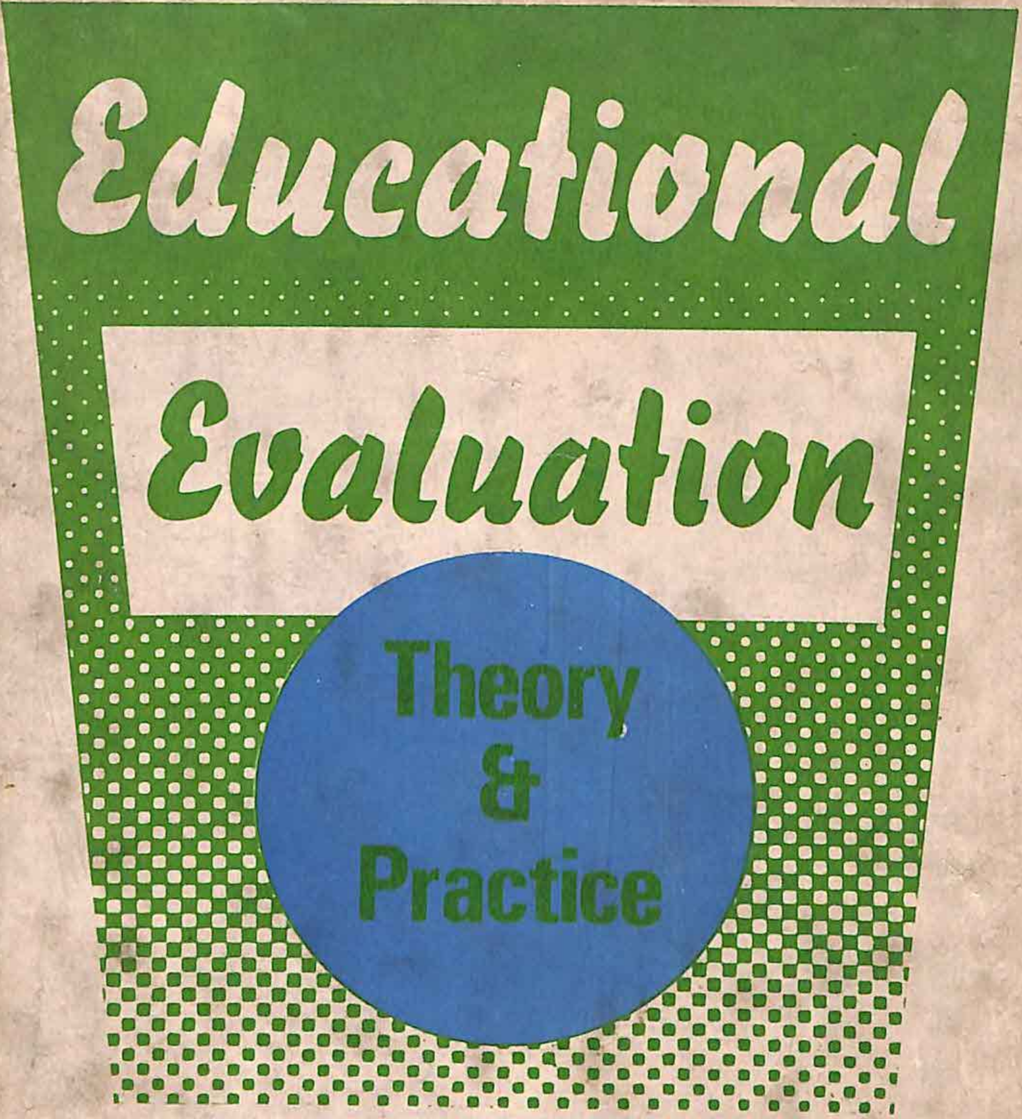

Educational Evaluation

Theory & Practice

Rambhai N. Patel

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EDUCATIONAL
EVALUATION
—THEORY AND PRACTICE

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PREFACE

If one wants to make decisions regarding educational problems connected with students, parents, teachers, administrators ; if one is interested in the learning outcomes of students ; if one believes that, in a classroom situation, all the three aspects of measurement—quantitative, qualitative and value judgement—are indespensable ; if one wants to make the teaching-learning process itself and its final product more effective, meaningful and fruitful ; if one wants to use the results of testing as feedback material which is extremely necessary—then educational evaluation is a *must*.

In short, educational evaluation cannot be separated from the teaching-learning process ; it is, in fact, an integral part of it.

This book covers both the theoretical and functional aspects of educational evaluation. In the beginning greater stress is laid on the theoretical aspect of the subject, but gradually the functional aspect is brought to the front. To make it absolutely functional, Part II of this book deals with some very useful concepts, and offers much useful information on elementary statistics. This approach is best suited to a teacher who is expected not only to know the theory of educational evaluation but also to prepare the year's plan, the unit plan, the unit test, and various tools to measure students' progress quantitatively and qualitatively, and to apply his knowledge of statistics with a view to fruitfully using the results of the various tests.

If you are a B. Ed. student or an M. Ed. student ; if you are a teacher or an administrator ; if you have a keen interest in evaluating your own method of teaching, or a student's learning experiences, or his scholastic achievement, or his knowledge, understanding, interests, attitudes and appreciation ;—then this book, partially or wholly, will give you some useful information. In short, if you are expected to play the part of a decision-maker at any level in the field of education, you will find in this book much to help you and guide you.

I take this opportunity to express my gratitude to those who have encouraged me to write this book, who have directly or indirectly helped me in my undertaking, and who have taken care to ensure that the get-up and set-up of this book is attractive.

Bombay. **R. N. Patel**

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1

Educational Decision-making

1.1. Educational Decision-making, a Must

Education is a dynamic process ; it is never rigid. So, in the field of education, a number of problems arise at every moment. Persons involved in education have to make a number of decisions at every step. Some of these persons, such as educators, administrators and principals, are connected with policy-making bodies. There are some who are in charge of the actual teaching-learning processes. Even parents are connected with the process of education. All these persons face educational problems of a quite different nature. For example, at the government level, the question to be decided may be whether the one-year course of the Diploma in Education should be discontinued and, if so, what provision should be made for the teacher-educators who are rendered surplus. Should the government start a correspondence course for the Diploma in Education ? At the level of a teacher, the problem may be of a quite different nature, such as, whether he should start the Mathematics Teachers Study Circle in his school. But all the same, it is true that the government, the department, the administrators, the educationists, the teachers, the pupils, the parents —*i.e.*, all those connected with education have to take a number of decisions, day in and day out. During the course of a school day, the principal, the teachers and other school personnel take a lot of decisions about academic and administrative matters and about students ; and they also help students to take many decisions for themselves.

Some of the typical questions facing the various personnel connected with education are illustrated below :

An educator wants to know the answers to the following questions :

(*a*) Should Modern Mathematics be introduced even at the primary level ?

(*b*) Should the curriculum be modified every three years ?

(*c*) How many languages should a pupil of a middle school learn ?

(*d*) At what stage should diversified courses be introduced ?

(*e*) Should English be a compulsory subject ?

Mr. Shah, the principal of a high school, wants to know :

(*a*) Should I arrange regular staff discussions for the enrichment of knowledge on various school subjects ?

(*b*) Should I give Mathematics of standard X to Mr. Bodani ?

(*c*) Would it be alright if the laboratory is shifted to the ground floor ?

(*d*) Would it be appropriate if the content test is held at the time of the admission of students ?

(*e*) What will be the effect on the performance of the students if the examination is held immediately after the Diwali vacation instead of before that vacation ?

Mr. D'Souza, a Science and Mathematics teacher, has these problems :

(*a*) What instructional aids should I use to introduce Newton's first Law of Motion ?

(*b*) How best should I introduce the concept of a circle in Modern Mathematics to my students ?

(*c*) What should be the duration of the unit test to be held at the end of the unit, say, "water" ?

(*d*) What type of homework should I give on the topic "Heart" in Std. VII ?

(*e*) What kind of blackboard summary should be developed while teaching "Parallel Lines" ?

A student, Ku. Ramdulari, tries to solve these problems :

(*a*) Which subjects should I offer at the S.S.C. class ?

(*b*) What should I do so that I may score better marks in English ?

(*c*) Next week, there is a debate on "Internal assessment is a blessing to students". Which side should I take, for or against ?

(*d*) Should I join the week-end course in Modern Mathematics organised by our Mathematics Study Circle ?

(*e*) What books should I refer to in order to get a clear concept of the Set Theory ?

A parent thinks :

(*a*) Should I advise my daughter to join a Law College ?

(*b*) To help my children in their studies, should I join the week-end course in Modern Mathematics ?

(*c*) Would it be proper for me to take my son to the farm when he is having his unit test next week ?

(*d*) Should I engage a tutor to help my daughter in her studies ?

(*e*) What kind of Science kit should I purchase, so that it may be helpful to my son in his study ?

These are just a few of the types of questions and decisions facing educators, principals, teachers, students and parents.

Educators have not only to take decisions but they will also have to assist individual pupils; parents and the general public in arriving at them. There are many types of educational decisions. Some will affect many people. For example : Should English be introduced in Non-English medium school in Std. V ? Should English be a compulsory subject for Non-English speaking students ? There are decisions which affectonly a single person. For example : Should Manish join an Arts College ? Should Neelam continue her studies ?

1.2. Bases of a Good Decision

Whoever takes a decision, however important or trivial, he should see to it that it is based on :

(*i*) as much information as possible ;

(*ii*) as accurate information as possible ; and

(*iii*) information which is as relevant as possible.

The more accurate the information, the better the decision is likely to be. A good decision is that which is based on *all relevant* and *accurate* information. Suppose a class teacher wants to find out the average height of 52 pupils in Std. VIII of his school ; he should get the height (and not the weight) of *all* the 51 pupils (and not a single less), using a reliable and valid instrument that gives an accurate measurement of height.

Accurate judgements and inferences are absolutely necessary for educational decision-makers. The realisation of educational goals depends very much on the accuracy of the judgements and inferences made by decision-makers. It is their responsibility to gather relevant and accurate data. This involves the use of tests, measurements and evaluation.

1.3. Test-Measurement-Evaluation

The concepts of test, measurement and evaluation are used in everyday school situations, for decisions are continually made by both school personnel and students. The terms *test*, *measurement* and *evaluation* are sometimes used interchangeably ; some scholars, however, make a distinction among them.

(A) Tests : The term *test* is the narrowest of the three terms, and may be defined in a variety of ways. We shall, however, use it in a somewhat restricted sense. It may be defined as follows :

> It is a device or procedure for confronting a subject with a standard set of questions or tasks to which the student is to respond independently and the results of which can be treated in such a way as to provide a quantitative comparison of the performance of different students.

Let us analyse the definition. The following are the important aspects of the definition :

(*i*) A test often implies the presentation of a standard set of questions to be answered or tasks to be performed.
(*ii*) It is the student who does this.
(*iii*) The student is to do this independently.
(*iv*) The test results in a measure (a numerical value) of a characteristic of the students.
(*v*) The test provides a quantitative comparison of the performance of different students.
(*vi*) It is a technique that yields only a verbal description ; for example, an interview technique is not a test.
(*vii*) Such devices as rating scales or checklists are not included in the test classification even if they yield quantitative results, for they are typically filled out by the teacher and do not consist of questions to which the student is to respond.

(B) Measurement : As a result of a test, a measure is obtained. An observation, a rating scale or any other device that allows us to obtain information in a quantitative form is a measurement. Measurement may be defined as follows :

> Measurement is an act or a process that involves the assignment of a numerical index to whatever is being assessed.

Thus measurement ascertains the extent or quantity of something. It has an intimate relationship with human beings. It is so closely related that it is rather difficult to say in which aspect of our life it does not exist. We measure the height, weight and age of a child ; we measure its intelligence, abilities in various fields, and so on.

Some of these measurements are physical and the tools used are metre, litre, gram, etc. Physical measurement is direct, simple and very accurate. Psychological and educational measurements are complex, for they cannot be measured through the system of physical measurement. The measurement of intelligence is expressed in terms of the Intelligence Quotient (IQ), that of scholastic achievement in marks or in grades.

Types of Measurement : Generally, there are three types of measurement : (*i*) Direct ; (*ii*) Indirect ; and (*iii*) Relative.

To find the length and breadth of a table involves direct measurement and this is always accurate if the tool is valid. To know the quantity of heat contained by a substance involves indirect measurement for we have to first find out the temperature of the substance with the help of a thermometer and then we can calculate the heat contained by the substance. To measure the intelligence of a boy involves relative measurement, for the score obtained by the boy in an intelligence test is compared with norms. It is obvious that psychological and educational measurements are relative.

In the physical world, the meaning of measurement remains the same because the units of measurement are fixed. Again, the measures are expressed in equal units and are also taken from a true zero. They constitute *ratio* scales. Centimetre-Gram-Second (CGS) scales found in the physical sciences constitute ratio scales. So do measures of density, force, velocity, quantity of electricity, etc. They may be added or subtracted, multiplied or divided. In ratio scales, a score of 30 is exactly twice the score of 15. For example, the length of 30 cm is exactly twice the length of 15 cm ; the force of 200 dynes is one-third the force of 600 dynes ; the velocity of 1200 m/sec. is five times that of 240 m/sec. and so on.

In behavioural sciences like psychology and education, the measures are generally not expressed in equal units, for they do not possess a true zero. These measures are known as *interval* scales. They cannot be added or sùbtracted, multiplied or divided. In interval scales, we cannot say that a score of 100 is twice as good as a score of 50. For example, a person having an IQ of 100 cannot be said to be twice as intelligent as a person having an IQ of 50 because neither score is taken from a true zero of "no intelligence". A student having a score of 56 in reading ability cannot be said to be twice as good as a person getting the score of 28 because neither score is taken from a true zero of "no reading ability".

The teacher generally deals with the marks (scores) of students. Suppose, Shakuntala's marks in Mathematics are 85, in Science 70 and in English 64. These marks cannot be added because one mark in Mathematics is not the same as one mark in Science, or one mark in Science is not the same as one mark in English.

Let us take another example. In Hindi, Neelam obtains 55 marks and Kishan 65 marks. We generally say that Kishan is better than Neelam in the subject of Hindi. But the interpretation is unscientific. This fact should be remembered by teachers, administrators and parents. To compare directly the marks obtained in one subject by two students of different classes or schools where two teachers having different abilities, knowledge, understanding, skill, attitude, etc. have taught the subject, is unscientific and therefore unreasonable.

(C) **Evaluation :** The last, but not the least, important stage in the process of gathering, using and imparting all relevant and accurate information is that of evaluation. It is defined in a variety of ways.

1. Evaluation is an act or a process that allows one to make a judgement about the desirability or value of a measure.
2. Evaluation is a process of delineating, obtaining and providing useful information for judging decision alternatives. (Stufflebeam et al.)
3. The word evaluation refers to the act or process of determining the value of something. For example,
   (*i*) A teacher *measures* Rahul's height to be 125 cm. She *evaluates* his height when she says that he is *short*.
   (*ii*) A teacher *measures* Hemlata's achievement in History to be 56%. She *evaluates* her achievement in History when she says that Hemlata's performance is *satisfactory*.
   (*iii*) Jagdish *measures* the size of his classroom and finds that it is 4m × 3m × 2.5m. He *evaluates* the classroom dimensions when he reports that the classroom is *too small* to be used for 40 students.
   (*iv*) Bharat and Mohan study in the same class. Bharat gets 85 marks in Geography while Mohan gets only 35. After getting these measurements, their parents *evaluate* their achievement in Geography when they say that, comparatively, Bharat's progress is *better*.

Thus, the data are all measurements until we assign a degree of quality to them. When we do so, we make an evaluation. In this way, a test results in a measurement which ultimately leads to evaluation.

Measurement helps in evaluation but is not the same as evaluation. Let us consider one example to clarify this difference. Manish and Bharat study in the same class. In the first test, they obtain 40 and 60 marks respectively in Mathematics. In the second test, both of them obtain 75 marks. Now, in the second test the measurement (test scores) of their achievement in Mathematics is the same, yet the evaluation will differ, when the teacher says that the rate of progress of Manish is comparatively better than that of Bharat.

1.4. Relationship between Measurement & Evaluation

Let us study the relationship between measurement and evaluation.

(1) Evaluation encompasses but goes beyond the meaning of the terms "test" and "measurement".

(2) Evaluation depends upon measurement but is not synonymous with it.

(3) Measurement is a quantitative determination of *how much* an individual's performance has been, while evaluation is a qualitative judgement of *how good* or *how satisfactory* an individual's performance has been.

(4) Sound evaluation is based upon the results of accurate and relevant measurement.

5. Measurement affords the evaluator a quantitative description of externalised knowledge and behaviour.

6. Measurement describes a situation; evaluation judges its worth or value.

7. Measurement is only a tool to be used in evaluation. By itself, it is meaningless, but without it evaluation is likely to be very erratic.

8. Not all uses of a test or a measurement in education can be considered evaluation, for evaluation involves appraisal in the light of some particular value, purpose or goal.

9. Evaluation is a continuous and comprehensive process covering every aspect of the educative programme. It is an integral part of education in which pupil and teacher are partners. Thus, evaluation signifies a wider process of judging students' progress. Measurement, on the other hand, implies only a precise quantitative assessment of instructional outcomes.

10. Evaluation is integrated with the whole task of education, and not only with measurement and examinations.

11. Evaluation goes beyond measurement in judging the desirability or value of the measure. Evaluation is not only quantitative but also qualitative and includes value judgements. Mathematically, it may be said that :

Evaluation = Quantitative description of pupils' achievements
+ Qualitative description of pupils' abilities
+ Value judgements about achievements and abilities.

For example, a B.Ed. student is evaluated by the teacher educator. The record reads as follows :

Evaluation : The student gets 70% marks in theory papers (quantitative description).

He cannot control the class, he never uses instructional aids, he is nor diligent, his Bb work is shabby and not methodical (qualitative description).

In view of both the descriptions above, he should be considered as a second class teacher.

In this chapter, we have discussed the meaning of evaluation in general. We shall now deal with educational evaluation in particular, with which the teaching community is much more concerned.

Evaluate Yourself

1. Explain what is meant by educational decision-making.
2. Illustrate some problems related to students' decision-making.
3. What are the bases of a good decision ?
4. Bring out clearly the relationship between
   (*a*) tests and measurement. (*b*) measurement and evaluation.
5. Discuss the different types of measurement with suitable illustrations.
6. How is evaluation defined ?
7. Explain : Evaluation depends upon measurement but is not synonymous with measurement.
8. Evaluate the following :
   - (*i*) Shakuntala is studying in Std. X. The average mark of a student in Mathematics in that class is 48. She obtains 64 marks in Mathematics.
   - (*ii*) Bharat's weight is 30 kg. at the age of 20.
   - (*iii*) Manish can take a long jump of 4.1 metres, while his classmate Vasudeo can take a long jump of 3.2 metres.
   - (*iv*) Rita's height is 160 cm at the age of 15.
9. Write short notes on :
   (*a*) Educational decision-making. (*b*) Types of measurement, (*c*) Evaluation.
10. State whether the following statements are true or false :
    - (*i*) Tests provide a qualitative comparison of the performance of different students.
    - (*ii*) Evaluation is an act that involves the assignment of a numerical index to whatever is being assessed.
    - (*iii*) Measurement describes a situation, evaluation judges its worth or value.
    - (*iv*) Educational decisions always affect many people.
    - (*v*) The information gathering process uses test, measurement and evaluation.
    - (*vi*) Differentiate evaluation from measurement.

2

The Concept of Educational Evaluation

2.1. Introduction

The modern concept of educational evaluation, which has evolved largely, though gradually, in recent decades, stemmed from a newer philosophy of education which calls for the development of more adequate techniques of assessing a pupil's growth and development.

This modern concept of educational evaluation—

1. puts the child, and not the subject matter, in the centre ;
2. caters to the child's psychological needs and interests, aptitudes, appreciation, etc. ;
3. puts more stress on learning than teaching.

This recent philosophy of education has emphasised the responsibility of the educator, not only for the development of concepts, information, skills and habits but also for the stimulation of a pupil's growth in understanding, application of what has been understood, attitudes, appreciation, interests, powers of thinking and personal-social adaptability.

Teachers have always been concerned with measuringand evaluating the progress of their pupils, which is an essential aspect of the educative process. Therefore, teachers need to have the necessary skills in the measurement and evaluation of their pupils' learning. At this juncture, it should be remembered that the goals of education have become more and more complex ; and since the number of pupils has increased enormously, the task has become more difficult. Before we define educational evaluation, let us study some terms involved in it.

The major function of a school is to facilitate learning. The kinds of behavioural changes in pupils we wish to bring about are commonly referred to as *instructional objectives.*

The subject matter to be grasped, digested and assimilated by the pupils, to be understood and applied to a novel situation is commonly known as *content.*

The means *e.g.*, methods, techniques which the class teacher employs to help pupils to learn the content on the one hand and to realize the objectives on the other hand constitute the *learning activities*.

The means of determining the extent to which learning activities have been effective are termed *evaluation procedures* (*testing*).

2.2. Modern Evaluation versus Older Forms of Evaluation

Modern evaluation differs from its older forms of appraisal in several ways :

(*a*) Modern evaluation attempts to measure a comprehensive range of objectives of the modern school curriculum rather than a subject-matter achievement only.

(*b*) Modern evaluation employs a variety of techniques, methods and procedures of appraisal, such as essay type tests, objective type tests, controlled observational techniques, self-report techniques, sociometric techniques, performance tests, diagnostic tests, projective techniques, etc.

(*c*) Modern evaluation includes integration and interpretation of the various indices of behaviour into an inclusive portrait of an individual.

2.3. Why Evaluation ?

The importance of evaluation may be stated as follows :

1. Evaluation is essential for sound educational decision-making.
2. Taxpayers (parents) are eager to know what the results of education are.
3. Educators, administrators, teachers, students and parents all work hard for the attainment of educational goals, and it is only natural that they should want to ascertain the extent to which these goals have been realised.
4. Education is truly a giant and an important enterprise. Therefore, it is crucial that we evaluate its process and products. For an adequate teaching-learning situation, evaluation techniques are essential.
5. Our system of education recognises the fact that "no two individuals are alike" and that they will play different roles in society. The special objectives of education are, to some extent, influenced by the abilities of the individual pupil. It is the responsibility of educators, parents and the pupils to find out which objectives are reasonable. A sound choice of objectives depends upon sound information about the pupil's abilities, interests, attitudes and

character. This information is obtained through the techniques of evaluation.

6. A good programme of evaluation clarifies the aims of education.
7. It helps in the improvement of the curriculum.
8. Evaluation attempts at relating the subject matter (content), classroom instruction (teaching-learning process) and testing procedures to educational objectives ; and it helps in developing a scientific approach to educational problems.
9. Evaluation helps administrators, teachers and students.

2.4. What is to be evaluated ?

From the foregoing discussion, the reader will have noticed that we never evaluate students. We evaluate the characteristics of students, *e.g.* their scholastic potential, knowledge of Algebra, honesty, perseverance, ability to teach, and so forth. This is not to be confused with evaluating the worth of a student. This distinction should be clearly kept in mind.

In the classroom situation, not only the content but also the achievement of the objectives and learning activities are to be evaluated. Content achievement and mastery over learning activities will be tested indirectly when objectives are evaluated.

2.5. What is Educational Evaluation ?

Education aims at an all-round development of a pupil and not merely at imparting knowledge to him. It is, therefore, necessary that teachers and educators should be equipped, not only with subject matter (content) and dynamic methods of teaching but also with objectives and appropriate testing devices which will assess a pupil's abilities.

Since the concept of evaluation in education is of recent origin, the teacher must clearly understand its importance and acquire an adequate knowledge of the necessary techniques.

From an educational point of view, the definition of evaluation may be given in the following words :

"Evaluation is any systematic, continuous process of determining—

(*i*) the extent to which specified educational objectives, previously identified and defined, are attained ;

(*ii*) the effectiveness of the learning experiences provided in the class room ;

(*iii*) how well the goals of education have been accomplished."

The following are the important aspects of this definition :

(*a*) Evaluation implies a *systematic* process which omits the casual uncontrolled observation of pupils.

(*b*) Evaluation is a *continuous* process. In an ideal situation, the teaching-learning process on the one hand and the evaluation procedure on the other hand, go together. It is certainly a wrong belief that the evaluation procedure follows (and that, too, after a good deal of time) the teaching-learning process.

(*c*) Evaluation emphasises the broad personality changes and major objectives of an educational programme. Therefore, it includes not only subject-matter achievements but also attitudes, interests and ideals, ways of thinking, work habits and personal and social adaptability.

(*d*) Evaluation always assumes that educational objectives have previously been identified and defined. This is the reason why teachers are expected not to lose sight of educational objectives while planning and carrying out the teacher-learning process either in the classroom or outside it.

(*e*) A comprehensive programme of evaluation involves the use of many procedures (for example, analytico-synthetic, heuristic, experimental, lecture, etc.) ; a great variety of tests (for example, essay type, objective type, etc.) ; and other necessary techniques (for example, sociometric, controlled-observation techniques, etc.).

(*f*) Learning is more important than teaching. Teaching has no value, if it does not result in learning on the part of the pupils.

(*g*) Objectives and accordingly learning experiences should be so relevant that ultimately they should direct the pupils towards the accomplishment of educational goals.

(*h*) To assess the students and their complete development brought about through education is evaluation.

(*i*) Evaluation includes all the means of collecting evidence on student's behaviour.

(*j*) Evaluation is more concerned with the growth which the student has made, than with his status in the group.

(*k*) Evaluation is continuous, an integral part of all training and testing.

(*l*) Evaluation is descriptive as well as quantitative.

(*m*) Evaluation is concerned with the total personality of the student and with gethering evidence on all aspects of personality development.

(*n*) Evaluation is a co-operative process involving students, teachers and parents.

(*o*) Evaluation is the determination of the congruence between the performance of objectives. Schematically, the concept of educational evaluation may be presented by showing the relationship among objectives, content, learning activities and evaluation procedures (testing) as follows :

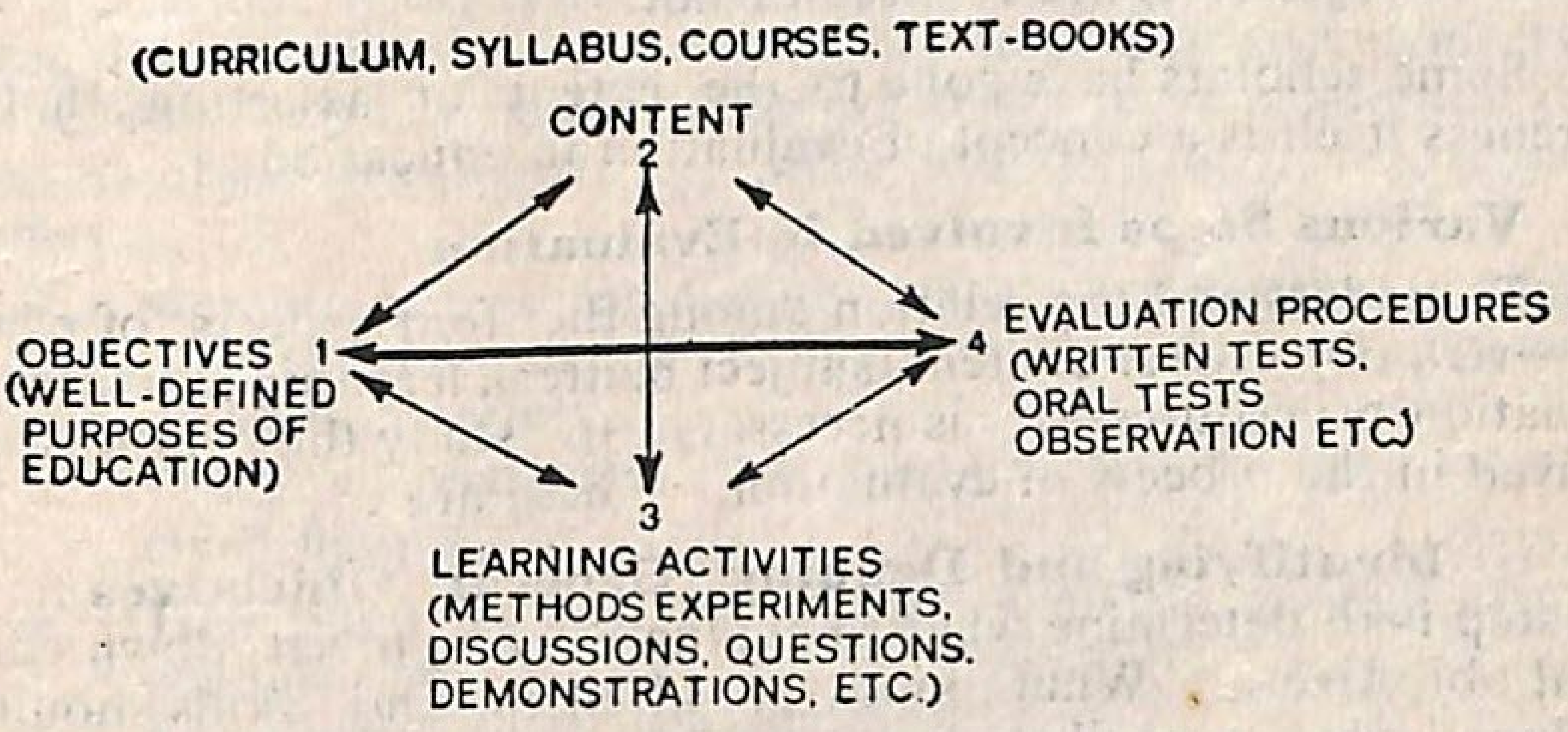

Fig. 2.1. Four aspects of educational evaluation.

Evaluation is thus a very comprehensive term. It involves objectives, content (subject matter), learning activities and evaluation procedures. Each of these four aspects is related to the remaining three. The use of the thicker bond between objectives and evaluation procedures (see the figure above) shows that the attainment of objectives is the main thing. Objectives are to be evaluated directly and content, learning experiences indirectly.

The inter-relationship of objectives, content, learning experiences and evaluation procedures (testing) clearly indicates that the process of evaluation is a continuous one and involves continual appraisal of objectives, of the teaching-learning process and of the testing procedures used by the classroom teacher. It is evident that one cannot pass judgement on the pupil by just testing him at the end of a course of instruction. It is also necessary for the classroom teacher to determine the pupil's status at the beginning of the course, at periodical intervals and then at the end of the academic year. Then and then only would he be in a position to judge a pupil's progress in achieving the objectives of instruction.

A problem will naturally arise : What does this concept of evaluation demand from the classroom teacher ? It demands the following things :

(*a*) An awareness of objectives at every stage of education.

(*b*) An awareness of the objectives of different subjects—

(*i*) while planning suitable curriculum, syllabus, courses and teaching points ;

(*ii*) while selecting and organising learning activities and while selecting instructional aids, various illustrations and methods ;

(*iii*) while framing test items, preparing a question paper, assessing answer papers and while interpreting the results.

(*c*) An awareness whether the well-defined purposes (*i.e.*, objectives) are realised or not.

Some scholars have gone to the extent of asserting that this awareness itself is a concept of evaluation in education.

2.6. Various Steps Involved in Evaluation

To understand the relation among the four aspects of evaluation—*viz.*, objectives, content (subject matter), learning activities and evaluation procedures—it is necessary to study the various steps involved in the process of evaluation. These are :

(*i*) **Identifying and Defining General Objectives** : The first step is to determine what to evaluate, *i.e.*, to set down educational objectives. What kind of abilities and skills should be developed when a pupil studies, say, Geography, for one year? What type of understanding should be developed in the pupil who learn his mother tongue? Unless the teacher identifies and states the objectives, these questions will remain unanswered.

The process of identifying and defining educational objectives is a complex one ; and there is no simple or single procedure which suits all teachers. Some prefer to begin with the course content, some with general aims, and some with lists of objectives suggested by curriculum experts in the area. The point of orientation, then, is the pupil and what he is like at the end of the teaching-learning process. While stating the objectives, therefore, we can successfully focus our attention on the product—*i.e.*, the pupil's behaviour—at the end of a course of study and state it in terms of his knowledge, understanding, skill, application, attitudes, interests, appreciation, etc.

For example, a Mathematics teacher, for the unit of "Triangle" identifies and states the following objectives :

1. The pupil acquires knowledge of the various terms used in regard to triangle, its types and properties.
2. The pupil understands how a triangle is defined by the use of set language, how triangles are classified into various types and the properties of different of triangles.

3. The pupil develops skill in drawing a triangle if the necessary data are given.
4. The pupil applies the acquired understanding of triangles, their types and properties to the solution of riders based on them.

(*ii*) **Identifying and Defining Specific Objectives** : It has been said that learning is a modification of behaviour in a desirable direction. The teacher is more concerned with a student's learning than with anything else. Changes in behaviour are an indication of learning. These changes, arising out of classroom instruction, are known as the *learning outcome*. What type of learning outcome is expected from a student after he has undergone the teaching-learning process is the first and foremost concern of the teacher. This is possible only when the teacher identifies and defines the objectives in terms of behavioural changes, *i.e.*, learning outcomes.

For example, before providing learning activities, a Mathematics teacher for the unit of "Triangle," identifies and defines the following specific objectives :

1. The pupil recognises the triangle or its types from the given figures.
2. The pupil recalls the terms such as triangle, obtuse triangle, etc.
3. The pupil defines 'triangle'.
4. The pupil compares the properties of different types of triangles.
5. The pupil draws a triangle if the measures of its two sides and an included angle are given.

These specific objectives will provide direction to teaching-earning process. Not only that but it will also be useful in planning and organising the learning activities, and in planning and organising evaluation procedures too.

Thus specific objectives determine two things : one, the various types of learning situations to be provided by the class teacher to his pupils and second, the method to be employed to evaluate both—the objectives and the learning experiences.

(*iii*) **Selecting Teaching Points** : The third step in the process of evaluation is to select teaching points through which the objectives can be realised. Once the objectives are set up, the next step is to decide the content (curriculum, syllabus, course) to help in the realisation of objectives.

It is the job of philosophers and educationists to decide the objectives and to frame the content accordingly, *i.e.*, curriculum, syllabus and course. For the teachers, the objectives and courses of school subjects are ready at hand. His job is :

(*a*) To analyse the content of the subject matter into teaching points.

(*b*) To find out what specific objectives can be adequately realised through the introduction of those teaching points.

Thus, for the teacher, the content analysis is the first step, while the second is to fix the specific objectives to be realised. While analysing the content, he has to keep in mind the objectives to be realised. At every moment, he has to bear both in mind—the objectives as well as the content.

(*iv*) **Planning Suitable Learning Activities :** Up till now, the process of relating objectives on the one hand and content (teaching points) on the other has been somewhat rather easy. In the fourth step, the process becomes complex. Here, the teacher will have to plan the learning activities to be provided to the pupils and, at the same time, bear two things in mind—objectives as well as teaching points. The process then becomes three-dimensional, the three co-ordinates being objectives, teaching points and learning activities. The teacher gets the objectives and content readymade. He is completely free to select the type of learning activities he would like to provide to his pupils so that the objectives may be substantially, if not completely, attained. He may employ the analytico-synthetic method ; he may utilise inducto-deductive reasoning ; he may employ the experimental method or a demonstration method ; or he may put a pupil in the position of a discoverer ; he may employ the lecture method, or he may ask the pupils to divide into groups and to do a sort of group work followed by a general discussion ; he may set an individual task, or he may organise educational visits ; and so on. He may ask students to use the text book or a reference book ; or he may employ audio-visual instructional aids. One thing he has to remember is that he should select only such activities as will make it possible for him to realise his objectives. Learning activities, moreover, help him to determine the evaluation procedures to be used in future.

(*v*) **Evaluating :** Here, the teacher observes and measures the changes in the behaviour of his pupils through testing. This step adds one more dimension to the evaluation process. While testing, he will keep in mind three things—objectives, teaching points and learning activities ; but his focus will be on the attainment of objectives. This he cannot do without enlisting the teaching points and planning-learning activities of his pupils. Learning activities provided by the teacher result in the learning experiences of the students. Here the teacher will construct a test by making the maximum use of the teaching points already introduced in the class and the learning experiences already acquired by his pupils. He may plan for an oral test or a written one ; he may administer an essay type test or an objective type of test ; or he may arrange a practical test. In any case, he will select the test through which he can best evaluate the objectives, the teaching points and the learning experiences of his students.

(*vi*) **Using the Results as Feedback :** The last, but not the least, important step in the evaluation process is the use of results as feedback. If the teacher, after testing his pupils, finds that the objectives have not been realised to a great extent, he will use the results in reconsidering the objectives and in reorganising the learning activities. He will retrace his steps to find out the drawbacks in the objectives or in the learning activities he has provided for his students. This is known as *feedback*. Whatever results the teacher gets after testing his pupils should be utilised for the betterment of the students.

The results of our evaluation provide feedback on the effectiveness of learning experiences and ultimately on the attainability of the objectives themselves for each student.

2.7. A Satisfactory Evaluation Programme

A satisfactory evaluation programme should permit :

(*a*) a wide range of freedom in curriculum materials ;

(*b*) provide for the measurement of more than just the ability to recall information ;

(*c*) produce an evidence of growth or progress towards the important objectives ;

(*d*) help to diagnose students' strength and weaknesses.

2.8. Functions of Evaluation

The following are the major functions of evaluation :

1. To make provision for guiding the growth of individual pupils.
2. To diagnose their weaknesses and strength.
3. To pinpoint areas where remedial measures may be desirable.
4. To provide a basis for a modification of the curriculum, syllabus or courses.
5. To provide a basis for the introduction of experiences to meet the needs of individuals and groups of pupils.
6. To motivate pupils towards better attainment and growth.
7. To test the efficiency of teachers in providing learning experiences and the effectiveness of instruction and of classroom activities.
8. To improve instruction.
9. To bring out the inherent capabilities of a student, such as proper attitudes, habits, manipulative skills, appreciation and understanding in addition to conventional acquisition of knowledge.

2.9. Examination and Evaluation

An examination generally tests a student's scholastic achievement, *i.e.*, his proficiency in the subject matter. In provides a situation in which only the objectives of knowledge and, to a certain extent, skill are realised. It does not go beyond that.

Evaluation, on the other hand, tests not only proficiency in a subject but also enables one to assess the realisation of the objectives of knowledge, understanding, skill, application of understanding, comprehension, expression, interest, attitude, appreciation, etc.

An examination is not a continuous process. It comes at the end of teaching. Evaluation, on the other hand, is a continuous process. The teaching-learning process and evaluation go together. This is, no doubt, an ideal situation. In practice, however, the teacher should at least try to minimise the gap between the teaching-learning process and evaluation.

The tools of an examination are only quantitative techniques while those of evaluation are quantitative as well as qualitative techniques.

2.10. Teacher's Role in Evaluation

The following factors have played a major role in modifying the modern concept of educational evaluation :

1. The child-study approach.
2. Individualisation of instruction.
3. The greater breadth and more functional nature of the modern curriculum.

The child-study and instructional uses of evaluation have tended to become more important than the administrative and supervisory uses. Hence, the teacher now has a key role to play in the evaluation process.

It is a fact that the teacher has achieved a more significant role in planning, organising and implementing the learning activities which afterwards result in learning experiences for his class. So, he has become responsible for appraising the worthwhileness of those experiences—the extent to which students have achieved instructional objectives.

In order to bring about changes in the structure and process of education, it is essential that workers in the field of evaluation devote themselves to an analytical study of the accepted educational objectives at different stages—*i.e.*, primary, secondary, junior college and degree college—and use their findings in a systematic manner in their day-to-day work.

The teachers then should (*a*) clarify these objectives in terms of a pupil's behaviour (specifications) or learning outcomes ; (*b*) analyse the subject matter (content) into teaching points by keeping the specifications in mind ; (*c*) plan for appropriate learning experiences ; (*d*) prepare appropriate testing devices for all accepted objectives ; and (*e*) use these devices for the development of the pupil through improved methods of instruction.

As educational process consists of a purposeful action which brings about desirable changes in a pupil, it envisages a continuous appraisal of the objectives and procedures of teaching-learning so that the whole process of education becomes a dynamic one.

Thus, it will be seen that, in the evaluation approach, when applied to the field of education, the teacher should ask himself :

(*i*) What is worth teaching ?

(*ii*) How best can it be taught ?

(*iii*) How well has it been taught ?

And the student should ask himself :

(*i*) What is worth learning ?

(*ii*) How best can it be learnt ?

(*iii*) How well has it been learnt ?

It is evident from the foregong discussion that the fundamental test of a sound education is its *effect* on the pupil. To a teacher with a clear concept of evaluation, changes in the behaviour of the pupil, in his thinking, feeling and actions are the basis for both his instruction and assessment. The programme of instruction cannot be successful unless desirable changes in behaviour occur in the pupil.

Furthermore, as the schools have committed themselves to the ideal of individualising instruction and meeting the students' needs so that all may learn more effectively, emphasis has been placed on accumulating and interpreting measurement data for individuals rather than for groups. Here, again, because of his daily opportunities to obtain additional information about his students and to put the measurement data to use, the teacher is the only key person.

The teacher's job as an evaluator has two essential aspects, neither of which can occupy his exclusive attention : one has its orientation in the group instructional programme and the extent to which the class, as a whole, is achieving its objectives ; and the other has its orientation in the study of individual students, in the *diagnosis* of their growth lags and in the discovery of the important causal factors for such lags.

Both approaches are significant aspects of evaluation and indispensable to good teaching.

2.11. Evaluation Helps the Administrator

Evaluation helps the administrator in educational decisions bearing on selection, classification and placement. For a proper placement either in ability-grouping or in achievement-grouping, evaluation is badly needed. Again, for guidance whether educational, vocational or personnel—systematic evaluation alone will serve the purpose. Thus, evaluation helps individual guidance and counselling.

2.12. Evaluation Helps the Teacher

Evaluation helps the teacher in a number of ways. These are :

(*a*) It provides him with knowledge concerning the studenst' entry behaviour. The importance of readiness to learn is a well-accepted fact. To teach effectively, we must find out where a student is and start from there. For that reason, we should have two things : (1) estimates of a student's capacity for learning ; and (2) estimates of what he currently knows. For example, we cannot provide learning situations to teach.

(*i*) long division to a student who cannot subtract ;

(*ii*) density to a student who does not understand the mass and volume of a substance ;

(*iii*) pronouns to a student who does not know nouns ;

(*iv*) how to calculate time at the various places on earth to a student who does not know longitudes.

(*b*) Evaluation helps the teacher in setting, refining and clarifying realistic objectives for each student. Knowledge of a student's entry behaviour obviously helps the teacher to set realistic objectives. The very act of building an evaluative device and carefully looking at the learning outcomes should help in refining and classifying these objectives.

(*c*) It helps him evaluate the extent to which the objectives have been achieved. For example, the teacher comes to know that

(*i*) only 25 out of 55 students in Std. VII A know how to read a centigrade thermometer ;

(*ii*) only 12 out of 44 students in Std. VII C have not understood the relationship between the volume and pressure of a gas at a certain temperature ;

(*iii*) forty out of 46 students in Std. IX B have understood the causes of earthquake.

(*d*) It helps him in determining, evaluating and refining his instructional techniques, *i.e.*, learning activities. The teacher can use the results of evaluation to improve his classroom procedures. For example, suppose he comes to know that only 10% of the students are able to find the refractive index of a glass. Now, he realises that he only demonstrated the experiment and the students have not performed the very experiment individually. He now arranges individual experiment to achieve the better understanding of the students with respect to how to find out the refractive index of a given glass slab. Thus, evaluation helps the teacher to schedule learning activities in any logical fashion.

(*e*) **Evaluation of learning outcomes :**

"Evaluation is a two edged sword which can (1) enhance learning and personality development or (2) be destructive of learning and personality development."—observes Bloom.

Accordingly, educators need to determine whether examinations and other evaluative procedures "have a positive effect on student learning and instruction" and whether they leave both teachers and students with a positive view of themselves and of the subject and learning process.

2.13. Evaluation Helps Students

Evaluation helps students in the following ways :

(*a*) **Communicating the teacher's objectives :** When the teacher's objectives are communicated, they become asset of the students, and this serves to increase their motivation. The reader will remember here the importance of the "statement of aim" in the Herbartian steps. Similarly, if the objectives are clearly known to them, they will know what the teacher expects from them, and they will help, directly or indirectly, the teacher in realising the objectives.

(*b*) **Increasing Motivation :** Knowing that one's performance is to be evaluated increases motivation, which ultimately facilitates learning. Thus, the evaluation process may serve to motivate students to do better and also to engage themselves in appropriate self-appraisal.

(*c*) **Encouraging Good Study Habits :** One aspect of good study habits is frequent review. Frequent evaluation encourages

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study habit. Because of frequent evaluation, a student gets to evaluate his own progress in school and also the development of certain skills. He also gets to know whether he can apply his acquired knowledge and understanding to a novel situation or not. This kind of evaluation will encourage him to build up good study habits.

(*d*) **Developing Abilities and Skills** : Evaluation helps students to determine the pattern of their abilities and to find out whether or not they have acquired the needed skills and understanding.

(*e*) **Summarising and Reporting Student's Progress** : Evaluation in education is useful to determine the effectiveness of instruction and planned learning activities and also to serve as a basis for summarising and reporting the progress of students.

(*f*) **Feedback** : Evaluation provides a feedback, which identifies a student's strength and weaknesses. One of the important aspects of learning is that the student should be aware of his strength and weaknesses. Evaluation and subsequent feedback to the student can play a major role in guiding his future efforts. In recent years, there has been an increasing awareness of the importance of feedback to the students and of teaching self-evaluation to students. There is enough evidence to show that such feedback improves subsequent performance. Teacher-made tests provide an extremely good technique for both feedback and learning experience. It goes without saying that even the experience of taking a test facilitates learning. In summary, then, students learn while studying for the test, while taking the test and while going over the test after it is completed.

There has been an increased emphasis in education on the importance of *feedback* to students. Of course, there are two stages to feedback :

First stage : The *measurement* of the degree to which a student has reached the objectives.

Second stage : The *communication* of this information to him.

Feedback to students serves the purpose of guidance. Researches agree that it is difficult to improve unless we know how we are presently doing. If one wishes to be a better marksman, he should know how close his previous shots have come to the bull's eye. Knowledge of results improves subsequent learning.

Students need information to guide them in their immediate demand (should I draw rough figure before I draw the fair one ? Should I take sin θ or tan θ to solve this problem ? Do I need to review Factor Theorem ?) or in their long range plans (should I join the Engineering College ? Should I go for law ?)

Besides *guidance*, a second possible purpose of reporting to students is to enhance *motivation*. The motivation dimension of feedback is more debatable than the guidance dimension. It is possible for feedback to either reduce or enhance motivation and the same reporting scheme may have differential motivating impact on different students. Teachers should take this into account. Some students need friendly encouragement, some need mild chastising, others may need to be motivated through fear.

Nevertheless, many educators and students firmly believe that feedback (and recording grades) does have the effect of including students to apply themselves to learning things they would not otherwise learn. Some educators feel this is bad and that students should feel free to learn what they wish.

Feldmesser points out :

Many students think, rationally to them, that the subject matter of a particular course, or particular parts of a particular course, are irrelevant to their needs and therefore ought not to be learned. We, teachers, might say that that's their business, if they choose not to learn, they will and should bear the consequences of their decision. It is shirking our educational duty. The students, after all, is young, and his very presence in a course indicates that he knows relatively little about the field. As a result, he doesn't necessarily know what will be relevant to his needs over the long run, and in any event, his needs and his interests change.

His teachers claim to have more foresight than he does particularly with reference to what will prove relevant in their fields. Thus, they are obliged to exert some pressure on the students to get him to learn material whose importance he is not yet in a position to perceive.

Evaluate Yourself

1. What are the factors which prove that the modern concept of educational evaluation stems from a new philosophy of education ?
2. Define :
   (*a*) Instructional Objectives ; (*b*) Content ; (*c*) Learning Activities ; (*d*) Evaluation Procedure.
3. What is educational evaluation ? Discuss the important aspects of the definition of educational evaluation.
4. Present schematically the concept of educational evaluation.
5. What does the concept of evaluation demand from the classroom teacher ?
6. Which are the various steps involved in evaluation ? Explain each of them.

7. Comment : "The classroom teacher does not evaluate the worth of a student."
8. Explain the importance of evaluation.
9. Explain clearly how evaluation helps
   (*a*) the administrator ; (*b*) the student ; and (*c*) the teacher.
10. Explain fully the teacher's role in evaluation.
11. Point out the difference between examination and evaluation.
12. How far does modern evaluation differ from the older one ?
13. Enumerate the major functions of evaluation.
14. State whether the following statements are true or false :
    (*a*) Evaluation is a continuous process.
    (*b*) The modern concept of evaluation puts the subject matter in the centre.
    (*c*) Teaching is more important than learning.
    (*d*) Evaluation demands an awareness of objectives at every stage of education.
    (*e*) Evaluation in no way helps educational decision-making.
15. Write short notes on :
    (*a*) Feedback. (*b*) Why Evaluation ?
16. "The use of modern evaluation technique is a positive step towards the improvement of education in general and the traditional examination in particular." Justify with illustrations.

3

The Role of Objectives in Educational Evaluation

3.1. Terms that Confuse the Reader

The role of objectives in education has been a reasonably controversial topic. This may be due to the use of some confusing terms, such as needs, goals, behavioural goals, aims, outcomes, objectives, behavioural objectives, etc., which have been used almost synonymously by some scholars but with sharply different meanings by others.

In this book, the terms *aims* and *goals* are used synonymously. The term *aim* is used in a general sense and as a very broad and wide term, while the term *objectives* is used in a more explicit sense. The statement of objectives contains a non-behavioural (non-action) verb—understand, appreciate, etc.

The terms *specification*, *specific objective* and *behavioural objective* are used synonymously. The statement of specification contains a behavioural (action) verb—write, read, draw, etc.

What occurs as a result of an educational experience, *i.e.*, learning experience, is termed as the *learning outcome*, while a stated desirable outcome before a student undergoes the learning experience is known as *specification*.

3.2. What is an Objective ?

The whole educational system is directed towards such aims such as utilitarian, cultural, vocational, all-round development of the student. For the classroom teacher, it is practically an impossibility to realise these aims fully, for they involve a total programme of education which a child can undergo not only in school but also at home and in the street. The school programme is *only a part* of the total educational programme, though it goes without saying that it plays an important and even a vital role in the realisation of educational aims.

Again, the realisation of educational aims may take a very long period, sometimes even one's whole life, while one's schooling is limited only to a certain number of years.

The question naturally arises : What can the school programme achieve ? It can achieve *only a part* of these aims, which we refer to as *objectives*. An objective is a part and parcel of an aim. It is a narrower term, while an *aim* is a very broad term. An objective can be realised through a school programme. As objectives are part and parcel of aims, they always originate from the aims. Now the classroom teacher, while planning and implementing a school programme, would invariably keep in mind the objectives beform him. The term *objective* may therefore be defined as follows :

> An objective is a point or an end-view of the possible achievement in terms of what a student is to be able to do when the whole educational system is directed towards educational aims.

Diagrammatically, this may be represented as follows :

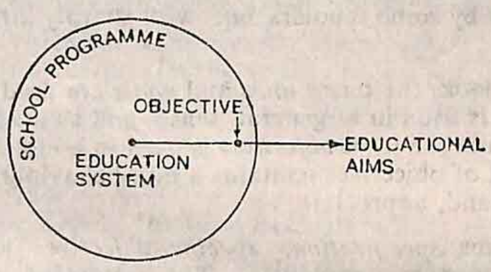

Fig. 3.1. An objective is an end-view.

To make the concept of an objective clearer, let us see how it may be differentiated from the term *aim*.

3.3. Aim and Objective

An *aim* and an *objective* may be differentiated as follows :

1. Aims are the directions in education. Education cannot progress in a desirable direction without aims. An objective, on the other hand, is a point showing the possible achievement in that direction. In other words, it is an end-view of the possible achievement.
2. It is the objectives that can be achieved not the aims. The achievement of aims is beyond the scope of the school programme.
3. Aims are the directions given to the entire educational system within and without the classroom. The aims of

education cannot be changed from subject to subject, while objectives may be changed from subject to subject. Objectives that can be realised through a study of the humanities may be different from those that can be attained through a study of such informative subjects as History, Geography, Mathematics, Science.

4. Objectives originate from aims. The attainment of each objective takes us one step forward in the achievement of an educational aim. If objectives are realised by stages, an educational aim may be achieved one day. The achievement of objectives indicates that the planning and process of education are in the direction of aims.
5. Aims, being so broad and wide, do not help in selecting the appropriate content of the subject. Objectives do help in this regard and not only that but they also help a classroom teacher in his day-do-day activities.
6. In his day-to-day work, aims, being broad and wide, become meaningless for a classroom teacher, while objectives being specific become meaningful.

Some illustrations of aims and objectives are worth studying.

Aims

1. To develop international brotherhood ;
2. To eradicate illiteracy ;
3. To create good and intelligent citizens ;
4. To establish a harmonious balance between the head and heart ;
5. To establish spiritualism in education.

Objectives

1. The pupil acquires knowledge of the location of the various countries in the world.
2. He understands the cultures of neighbouring countries.
3. He applies the knowledge already acquired about the properties of quadrilaterals to solve riders.
4. He develops his skill in handling the science apparatus.
5. He comprehends a given piece of literature.

3.4. Why Have Objectives ?

The statement that there are too many fanatics in education is not without some truth. A fanatic is one who, having lost sight of his goals, redoubles his efforts. It is, therefore, absolutely necessary to establish aims (goals) in education, for without them we have no way of knowing in which direction we are going, Once the aims are fixed, the educator can suitably frame a curriculum. Aims can help us to formulate objectives. By keeping both objectives and curriculum in view, we can further divide the curriculum into "standardwise" syllabus and "subjectwise" courses.

Now the teacher has subjectwise objectives on the one hand and, on the other, the subject matter, *i.e.*, content.

For providing a learning experience to students, the teacher has to analyse the content of a course. This is known as content analysis. After providing a learning experience, and in order to know the learning outcome and realise objectives, he evaluates his students' achievements. Evaluation, as we have already seen, helps the teacher to refine the objectives.

Thus, there is a circular relationship between objectives, the teaching-learning process and evaluation. One needs to set tentative objectives, employ an educational strategy to reach those objectives (*i.e.*, to provide learning experiences for students), measure the degree of attainment with the help of a variety of evaluation procedures, and then re-evaluate both objectives and strategy. This completes a cycle.

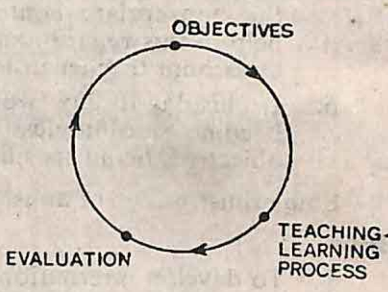

Fig. 3.2. A circular relationship.

3.5. Why State Objectives ?

We have seen above that, for the classroom teacher, objectives are more important than educational aims, as far as his day-to-day work is concerned. The following are some of the reasons for stating objectives before he begins to communicate learning experiences to his class :

(*a*) An aim is a direction in education. An objective is a point in that direction. Therefore, objectives give direction to education. They tell the classroom teachers in which way to go, a decision that is of paramount importance before the first step is taken on an educational journey.

(*b*) Specifically, objectives help the teacher in instructional planning, guide students' learning and provide a criterion for evaluating their learning outcome.

(*c*) Objectives aid in evaluation which again helps us to refine objectives. The measurement of what education *has* achieved may be useful for determining what education *should* achieve.

(*d*) Persons concerned with education are more likely to have a clear idea of what the outcomes of education *ought* to be.

3.6. Sources of objectives

The sources of objectives of education are many and varied, and are interrelated, for the latest developments in education depend upon many interrelated factors. Some of these sources are mentioned below ; and they are treated separately only for the sake of convenience.

1. The first and foremost source of objectives is the philosophy of life of a nation, which naturally reflects on its philosophy of education. One of the accepted definitions of education is that "education is philosophy put into action." If the philosophy is changed or modified, the content of education, too, would change or be modified, which would ultimately affect educational aims and objectives. For example,

(*a*) The philosophy of education in India after independence (1947) is different from what it was before independence. Independence has led to a change in our educational aims and objectives.

(*b*) The objectives of education in the U.S.A. differ from those in the U.S.S.R. because of the differences in the philosophy of life of these two nations.

The other sources indicated below are directly or indirectly related to the philosophy of education ; but they may be considered and studied independently.

2. The needs of a nation are an important source of the objectives of education. If these needs change, the objectives, too, would change. For example,

(*a*) After independence, India rapidly switched over to industrialisation. The advances in industry were possible because of the development of science and technology. So, one of the objectives of education in India has been to develop an understanding of science and its application in the new situations that may arise.

(*b*) In a big country like India or the U.S.S.R., the needs of the state become a source of objectives of education. For example,

(*i*) The countries along the border of India may have a knowledge of military science as an objective, while a state like Gujarat may have the learning of commercial Arithmetic as one of the objectives and a coastal state like Kerala may have the acquisition of a knowledge of fishery as an objective.

(*ii*) By switching over from the old approach to Mathematics to a new one the nation showed that its needs had changed. Accordingly, the objectives of learning Mathematics also changed.

(*c*) In the same State, the objectives of education in rural and urban areas may differ. Rural areas may demand the objectives of education to be related to the needs of agriculture and the allied small industries, while the objectives in urban areas would be related to industry and other allied activities.

3. The social environment, economic structure, political order and cultural heritage of a nation are also important sources of the objectives of education. In a developing country like India, these objectives differ from those of a developed country like the U.S.A.

4. The psychological needs of a child are also one of the sources of the objectives of education. At different stages of his development, a child's needs undergo a change. Accordingly, the objectives ought to be different. The needs of primary school children are different from those of college students ; and so the objectives of education differ.

Even at the same stage of development, the needs of a boy-student and of a girl-student may differ and may necessitate the setting up of different objectives.

In short, the needs of individuals, of society and of the nation go on changing in different places and at different times calling for a change in the objectives of education. The moment the objectives of education become static, education becomes stagnant and meaningless.

3.7. Taxonomies of Educational Objectives

The taxonomy of educational objectives. is basically a classification scheme. Taxonomies have classified the objectives of education. It is a matter of fact that the meanings of terms like "to understand", "to analyse," "to respond" as understood by the farmers of a curriculum may differ when they are interpreted by an evaluator. Again, two evaluators or two teachers may interpret the various terms in their own way if the precise meaning of these terms is not communicated to them in the same way.

The most important purposes of a taxonomy are :

(*a*) To establish the accuracy of communication regarding the objectives of education ;

(*b*) To reduce the vagueness arising out of such loosely defined terms and concepts as "to know", "to reason", "understanding", "interest", etc., and to understand the relationship among them ;

(*c*) To become a means of a more precise communication system in the field of education ;

(*d*) To establish a common understanding about an hierarchical classification of objectives ;

(*e*) To become a means of understanding the sequence and organisation of human development ; and

(*f*) To be a great help in clearly defining and meaningfully evaluating the educational standards of a school.

Taxonomies have been divided into three domains—cognitive, affective and psychomotor. A student's development is always studied under these three categories.

Domain of instructional objectives :

In developing a classification system of instructional objectives, the most systematic approach is the 'taxonomic system'.

Its purposes are as follows :

1. to enable the teachers, curriculum workers and testing specialists to communicate more effectively in discerning the nature and scope of instructional goals ;
2. to help educators to plan and evaluate learning experiences more effectively ;
3. to compare existing curriculum goal, with a wide range of possible outcomes ;
4. to increase the possibilities of developing a broader spectrum of goals and outcome ; and
5. to classify the intended behaviour of students as a result of participating in one set of instructional experiences, and to be used in obtaining evidence on the event to which such behaviours are manifest.

Three-fold divisions of Instructional Objectives

Cognitive	Affective	Psychomotor
(the recall or recognition of knowledge and the development of intellectual abilities and skill).	(changes in interests and values, and the development of applications).	(development of manipulative or motor-skills).

Psychomotor objectives are dealt with in a variety of learning activities like handwriting, speech, typing, physical education, laboratory sciences, industrial arts, vocational and technical education.

Interdependence and continuity

Modern behavioural science reveals that humans do not think or behave without feeling but respond as total organisms or as whole beings.

It was noted by the developers of the texonomies that, "...... no objective in class was entirely devoid of some components of the other two classes." The cognitive and affective processes are interdependent and virtually inseparable in all kinds of situations involving human learning.

The interdependence of the 3 domains in relationship to the learners system of needs and developmental tasks is shown schematically in the Figure 3.3 on page 36.

In effective learning these spheres are marked not by separation and isolation but by continuity and interdependence. Nevertheless it is useful for teachers and curriculum workers to examine these so-called domains *separately*. Why ?

1. to develop teaching-learning strategies and evaluative measures that are fully representative of the broad spectrum of cognitive goals that are attainable,
2. to develop teaching-learning strategies that are representative of affective goals relevant to the curriculum and
3. to develop needed interrelationships between cognitive and affective goal, in the teaching-learning process and in the evaluation of achievement.

3.8. Cognitive Domain

This includes those objectives which deal with thinking, knowing and problem solving.

> The cognitive domain includes those objectives which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills.*

Cognitive taxonomy contains six major classes of objectives arranged in an hierarchical order on the basis of complexity of task and arranged from simple to complex behaviour and from concrete to abstract behaviour. Each of these six classes is subdivided further. A condensed version of the cognitive domain taxonomy is presented in the following table :

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* Bloom, Benjamin S. and others : Taxonomy of Educational Objectives. Handbook I, Cognitive Domain (1956).

Table : Condensed version of the Cognitive Domain Taxonomy of Educational Objectives (Bloom 1956).

1. **Knowledge :** It involves the recall of specifics and universals, methods and processes, or of a pattern, structure or setting.
    - (*a*) Knowledge of terminology and facts ;
    - (*b*) Knowledge of conventions, trends and sequences, classification and categories, criteria, methodology ;
    - (*c*) Knowledge of principles and generalisations, of theories and structure.

INTELLECTUAL ABILITIES AND SKILLS

2. **Comprehension :** It represents the lowest level of understanding and includes translation, interpretation.
3. **Application :** The use of abstractions in particular and concrete situations.
4. **Analysis :** The breakdown of a communication into its constituent elements or parts so that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit.

This includes an analysis of elements, relationships and of organisational principles.

5. **Synthesis :** The putting together of elements and parts so as to form a whole.

This includes the production of a unique communication, of a plan or proposed set of operations and derivation of a set of abstract relations.

6. **Evaluation :** Judgements about the value of material and methods for given purposes.

This includes judgements in terms of internal evidence and of external criteria.

Cognitive Objectives

'Knowing' the rules, definitions, formulae etc. is like knowing the names of parts of a machine without knowing what they do, what their functions are, how they function. In traditional schooling, mere information is taken as knowledge and such information is to be learned by rote and reproduced on the examination paper by the students.

Because such information is not based upon (1) understanding and (2) interpretation and because is does not involve (3) application in a variety of new situations, it is readily forgotten.

"Knowledge is not merely a state of consciousness but consists of (1) what we consciously do or make use of in understanding what is happening in straightening out a perplexity by conceiving the connection between ourselves and the world in which we live" (Dewey).

If this is accepted then much of what is taught in the class·room and tested for in teacher made achievement tests is not knowledge but mere information.

Moreover knowledge is not something that exists apart from interests, attitudes, appreciations and values. Our feelings or emotions cannot be separated from our capacity to learn and to act thoughtfully within and upon our Environment. Man's development of new knowledge and the uses to which such knowledge is put, is governed by interests, attitudes, appreciations and values.

3.10. Affective Domain

It includes those objectives which deal with attitudes, values interest and appreciation.

"The affective domain includes those objectives which are concerned with changes in interest, attitudes and values and the development of appreciations and adjustment*."

Affective taxonomy is divided into five major classes arranged in an hierarchical order on the basis of the level of involvement. A condensed version of affective domain taxonomy is presented in the table on the next page :

If the objectives in the affective domain are attended to and are achieved, the evaluator will be in a position to predict the behaviour of an individual. The evaluator, then, can answer such questions as :

1. Would Sarala be able to appreciate Newton's contribution to Mathematics ?
2. Would she actively attend to a picture of a rainbow ?
3. Would she willingly receive the phenomenon of osmosis in nature or the pattern of the veins of a leaf ?

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* Krathwohl, Bloom and Maria : Taxonomy of Educational Objectives, Handbook II : The Affective Domain (1964).

4. Would she join a weak-end course in Music organised by the Music Club of her school ?
5. Would she read a book on "The Ecology of Human Organism" on her own ?

Table : Condensed version of the Affective Domain Taxonomy of Educational Objectives (Krathwohl et al. 1964)

1. **Receiving (attending)** : This means that the learner should be sensitised to the existence of certain phenomena and stimuli. This includes awareness, willingness to receive and controlled or selected affection.
2. **Responding** : This is concerned with responses that go beyond merely attending to phenomena. A person is *actively* involved in attending to them.

This includes acquiescence in responding, willingness to respond and satisfaction in response.

3. **Valuating** : This includes acceptance of a value, preference for a value and commitment to or a conviction in regard to a certain point of view.
4. **Organisation** : For situations where more than one value is relevant, the need arises for (*a*) the organisation of the values into a system, (*b*) the determination of the interrelationship among them, and (*c*) the establishment of the dominant and pervasive value.

It includes conceptualisation of a value and organisation of a value system.

5. **Characterisation by a value or value complex** : At this level, the already existing values are organised into some kind of an internally consistent system and control the behaviour of an individual, who attains an integration of his beliefs and attitudes into a total philosophy.

3.11. Psychomotor Domain

"The psychomotor domain includes those objectives which deal with manual and motor skills."

A comprehensive taxonomy of objectives in the psychomotor domain has not been completed, but both Simpson* (1966) and Kibler *et al.* (1970) have begun a systematic classification in this area. Dr. R. H. Dave has proposed a taxonomy in the psychomotor domain in the form of a working hypothesis. This proposed taxonomy is based on the concept of co-ordination between various muscular actions. Behaviour which includes muscular action and requires neuro-muscular co-ordination is grouped under this domain. The teacher's job is to provide such activities as may help develop neuro-muscular co-ordination.

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*Simpson, 1966, and Kibler et al., 1970.

The educational objectives, tentatively proposed under this domain, are :

1. **Imitation** of an action, performance ;
2. **Manipulation** of an act. This includes differentiating among various movements and selecting the proper one ;
3. **Precision** in reproducing a given act. This includes accuracy, proportion and exactness in performance ;
4. **Articulation** among different acts. This includes co-ordination, sequence and harmony among acts.
5. **Naturalisation** : Here a pupil's skill attains its highest level of proficiency in performing an act with the least

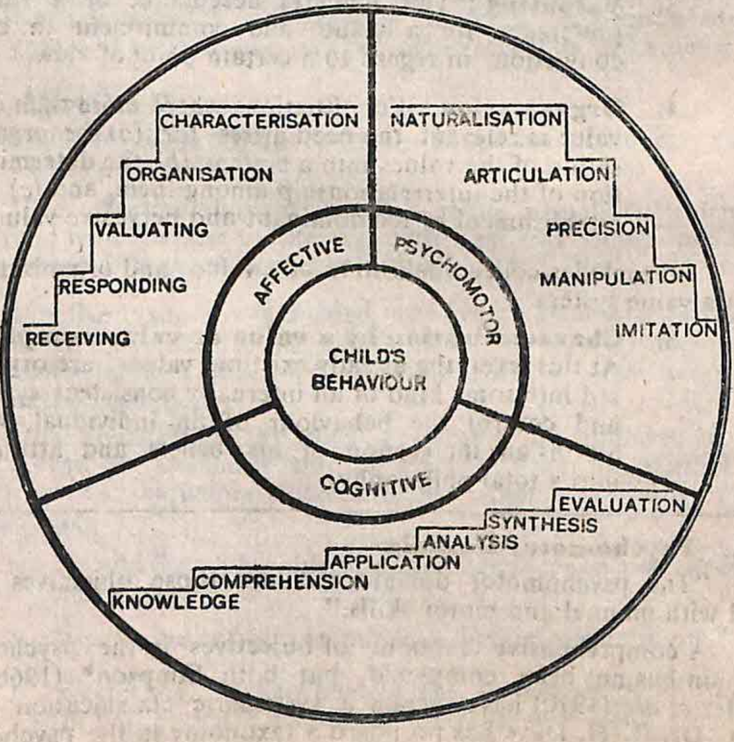


Fig. 3.3. Objectives of Cognitive, Affective and Psychomotor Domains.

expenditure of psychic energy. The act becomes so automatic that it is attended to unconsciously.

Thus the behaviour of a child is governed by his development in three domains : cognitive, affective and psychomotor. The diagram on page 36 shows all the three taxonomies.

The cognitive domain is mainly concerned with the *ability* of a student to do a task, while the affective domain is concerned with the *will* or *desire* or *attitude* to do that task. However great is the ability of a student to *do* a task, it will not be done if he is not willing to do it. The affective domain, therefore, is no less important than the cognitive one. Hence the teacher should put an equal emphasis on the affective domain in the process of evaluation.

Now the question that arises is : How is a task to be willingly performed ? If it demands both ability and attitude (or will or desire) it is obvious that neuro-muscular co-ordination is a *must*. This shows the importance of the psychomotor domain in the behaviour of a child. If the cognitive and affective domains are the theoretical aspects of human behaviour, the psychomotor domain is the practical aspect, without which the theoretical aspects will have no meaning.

3.12. How Taxonomies Help in Evaluation

1. They help us in analysing and classifying objectives.

2. They give us an idea of how the all-round development of a child can be achieved. If we over-emphasise one domain, and in the school programme generally we put more emphasis on cognitive taxonomy, the development of the behaviour with respect to the other two domains will be incomplete. For the all-round development of a child, all the three domains are equally important. So the teacher, while planning objectives and providing learning activities, should keep this in mind.

3. Taxonomies provide a basis for a precise comparison of two curricula, syllabi or courses.

4. The same topic of a subject may be taught in different standards because of the concentric approach which is psychological but the levels of the objectives are different. In deciding these levels, from simple to complex, or from concrete to abstract, the taxonomies provide a guideline.

5. Taxonomies also help us in evaluation procedure. Questions are to be set keeping in view these taxonomies and the hierarchical order of the objectives in each. The tests would then help us to evaluate the entire behaviour of a child ; and, again, the different levels will be covered. Thus taxonomies will enable us to give a new direction to paper-setters and evaluators.

6. The affective domain is concerned with those objectives which play an important role in the development of the values of life. For teachers, this is of paramount importance, for it helps them to realise these objectives for their students.

7. If the teaching-learning process includes all the three domains, each having a proper weightage, a harmonious balance in the behaviour of a child may be expected.

8. Taxonomies increase the validity and reliability of the testing procedure.

9. Taxonomies also give guidelines to teachers on how they should report the progress of a child to his parents. Not only the marks obtained in a subject should be reported but also an evaluation of his abilities in the affective and psychomotor domain. This makes the progress report more meaningful.

3.13. Classification of Objectives

Objectives may be classified in a variety of ways. One point, however, must be made clear at this stage. The classification of objectives in a particular group emphasises the dominance of objectives in that group rather than the total exclusion of other objectives from the classified group. This is so because one's abilities do not develop compartment-wise. Let us take one objective.

"The pupil applies the knowledge of the properties of parallel lines in solving riders".

This requires the application of understanding, *i.e.*, this objective is classified under the cognitive domain. Now, when he solves such riders he may develop skill in drawing accurate figures, which comes under the psychomotor domain. By this time, it is quite possible that he gets interested in the subject of Mathematics, which comes under affective domain.

In short, the same learning situation may give rise to the development of objectives which may be classified under different groups.

Objectives may be classified on the basis of various principles, *e.g.*, on the basis of (1) Ability, (2) Length of time, (3) Achievement in the classroom, and (4) Observable and Measurable Behaviour.

Let us scuss the classifications in detail.

I Ability-Based Classification

(*a*) **Objectives of the Cognitive Domain** : As we have seen earlier, objectives concerned with knowledge as well as intellectual abilities and skills may be grouped under this domain. know that our five senses are the gateway to knowledge. So the abilities based on factual information through the five receptors, *viz.*, through seeing, hearing, smelling, tasting and touching may be grouped here. The development of intellectual abilities and skills depends primarily upon the knowledge acquired.

Some of the illustrative statements of objectives under this classification are :

1. The pupil *acquires a knowledge* of...(The parts of a flower/The terms related to "profit and loss"/The basic elements of a language/New words/Climate and vegetation of a country/Spread of Buddhism/Ashok's administration/Alexander's invasion/etc.).

2. The pupil *develops an understanding* of...(The properties of a right-angled triangle/The laws of motion/Buddhism/The relationship between longitude and latitude/Causes of revolutions/etc.).

3. The pupil comprehends...(The given passage in Hindi/ The poem recited in Marathi/etc.).

4. The pupil *applies his knowledge and understanding*...(To solve riders/To bring out the ideas and emotions of the given poem/ To find out the time of a given place on earth/To predict the outcome of a particular political policy/etc.).

5. The pupil *develops a skill* in... (Reading tables of logarithms/Reading maps and charts/Expressing ideas in a logical sequence/Making models of forts/Reading source material/etc.).

(*b*) **Objectives of the Affective Domain** : The objectives dealing with changes in interest, attitudes, values, the development of appreciations and adjustment may be classified under this category.

Some of the illustrative statements of objectives under this classification are :

1. The pupil *develops an interest* in ... (History/Composing poems/Reading autobiographies of Scientists/Preparing models, charts/Reading historical novels/Seeing historical films/etc.).

2. The pupil *develops attitudes* (scientific and social).

3. The pupil *appreciates* ... (A given piece of literature/The beauty of a rainbow/The mechanics of a language/etc.).

(*c*) **Objectives of the Psychomotor Domain** : The objectives dealing with those abilities which need understanding and physical skills may be grouped under this category. These abilities may be developed by observation, by imitation, or by trial and error.

Some of the illustrative statements of objectives under this classification are :

1. The pupil *develops skills in* ... (Filling information on outline maps/Preparing models, charts, diagrams/Drawing geometrical figures/Setting appratus/etc.).

2. The *pupil expresses* ...(Ideas orally/Ideas in writing with good speed and with correct punctuation/etc.).

II Time-Based Classification

The development or achievement of different objectives takes different periods of time. Some of the time may be developed or achieved soon, while others may take a long time. These objectives are named *Short-ranged* objectives *vs* *Long-ranged* objectives or *Immediate* objective *vs* *Ultimate* objectives.

(*a*) **Short-Ranged or Immediate Objectives** : Objectives of the cognitive and of psychomotor domains take comparatively less time in development or achievement than those of the affective domain. The acquisition of knowledge and the development of intellectual abilities and skills with respect to a particular subject-matter area will require comparatively less time than to develop interest, attitudes, and appreciations in regard to that area. So the objectives under cognitive and psychomotor domains may be classified as *short-ranged* objectives while those under the affective domain may be classified as *long-ranged* objectives.

The short-ranged or immediate objectives will include the following objectives :

1. The pupil *acquires knowledge* of...
2. The pupil *develops an understanding* of...
3. The pupil *comprehends*...
4. The pupil *applies his knowledge and understanding in*...
5. The pupil *develops his skill* in...
6. The pupil *expresses*...

(*b*) **Long-Ranged or Ultimate Objectives** : The objectives under the affective domain take comparatively a longer period for their development or achievement than those under the cognitive or psychomotor domain. That is why they are termed *long-ranged* or *Ultimate objectives*.

The following objectives are included in this category :

1. The pupil *develops an interest* in...
2. The pupil *develops an attitude*...
3. The pupil *appreciates*...

III Nature of Achievement-Based Objectives

(*a*) **Classroom Instructional Objectives** : Objectives, which can be achieved with definite methods of, and approaches to the learning situations in the classroom or outside it, are known as *classroom instructional objectives*. The objectives of cognitive and psychomotor domains come under this category; that is, the objectives of knowledge, understanding, comprehension, application of knowledge and understanding, skill and expression, may be classified under this category.

(*b*) **Personality Objectives** : Objectives that lead to the common aim of education, *i.e.*, the development of personality, are known as *personality objectives*. The objectives of the affective domain, *viz*., interest, attitudes, and appreciation, come under this category.

IV Behaviour-Based Objectives

(*a*) **Non-Behavioural or General Objectives** : Those objectives which are stated at very general level are known as *general* objectives. They are so general as to be vague and therefore meaningless, at least for the classroom teacher. As these objectives do not a contain a behavioural verb (action verb), they are also known as *non-behavioural objectives*. For example,

1. The first objective of education for democracy is a full, rounded and continuing development of a person.
2. To understand international dependence.
3. To promote international understanding between India and the neighbouring countries.
4. To develop the power of appreciation of the beauty of Nature.
5. To develop the right attitudes towards family planning.

(*b*) **Behavioural or Specific Objectives** : Those objectives which are stated at a very specific level are known as *specific* objectives. They are also known as *specifications*. They are so specific as to be clear and, therefore, meaningful. As these objectives contain a behavioural verb (action verb), they are also known as *behavioural* objectives. For example,

1. The pupil adds all the combinations of single digit numbers.
2. The pupil points out the figures of speech in a given paragraph.
3. The pupil illustrates the names of the religious reformers of India.
4. The pupil defines isobars.
5. The pupil copies the blackboard summary without omissions and mistakes.

3.14. Cognitive and Affective Evaluation

The relative importance of these two types of objectives is a matter of controversy. Some educationists lay greater stress on cognitive objectives, while others do so on affective objectives. At present, in India, it seems that teachers place greater emphasis on cognitive objectives. However, most educators agree on two things :

(*a*) that affective objectives are of some concern in education ;

(*b*) that teachers do an even poorer job in evaluating affective rather than cognitive objectives.

As Krathwohl *et al.* (1964, p. 15) have pointed out : "Only rarely did we find an affective evaluation technique used..."

The question naturally arises : Why do educators do an inefficient and inadequate job when measuring affective objectives ? One reason is that both teachers and parents simply do not value affective objectives highly enough.

The post-sputnik era demands high intellectual competence. For example, if students learn to read at age five it is reasoned that they should. Parents generally prefer content-oriented teachers to value-oriented ones. They also prefer to have the school report of their children's progress in cognitive abilities and skills rather than in the affective domain. Pratically they neglect the report on the affective domain, if any. Not that the teachers do not value the affective objective ; they, however, lack any feeling of personal responsibility or accountability.

Another reason that may keep teachers from trying harder to measure affective objectives is the implicit belief of many that if cognitive objectives are attained, there will be a corresponding change in appropriate affective behaviours.

Researches, however, do not support this view. Adkins and Kuder (1940) showed that there is really very little relationship between aptitudes . and interests. Mayhew (1958) reported that there is very little relationship between attitude changes and the growth of knowledge in a student taking a college course. A skilful teacher may use the development of cognitive skills to increase motivation, and increased motivation to strengthen cognitive skills ; but neither of these follows automatically from the other.

In fact, it is entirely possible that the development of cognitive behaviour may inhibit or destroy the development of affective behaviour. Inappropriate methods of teaching multiplication facts, geometric proofs, history or poetry are obvious examples of areas in which a method of teaching may develop cognitive skills and inhibit positive affective behaviour. Many students acquire the skill to read ; but how many of them find joy or excitement in reading ? The result is that they seldom read on their own.

This shows that a teacher interested in accomplishing both types of objectives must evaluate both *separately* and not assume that one follows from the other.

Another reason why affective behaviour is under-evaluated in school is that it is very difficult to change it or to measure it accurately.

The techniques of attitude-change are not nearly so well developed or so successful as the techniques for attaining cognitive objectives. But their results are not usually immediately apparent. The measurement of affective behaviour is difficult because it can be so easily faked. It is easier to fake an interest in something than to fake knowledge or skill. Both teacher and student should therefore recognise that a student's attitude should not affect the teacher's judgement about his cognitive skills.

Measurement in the affective domain is difficult. What are the reasons ?

(*a*) Lack of behavioural objectives. Educators have done far too little in stating affective domains behaviourally ;

(*b*) Educators do not try to evaluate whether or not affective objectives have been attained.

3.15. How to Improve Affective Evaluation

In spite of the difficulties inherent in the evalution of the affective domain, teachers should make a greater effort in this area. In this age, we need to promote fellow-feeling, honesty, responsibility, co-operation, independence, etc. More graduates and post-graduates are fired from jobs because of inability to get along with others than because of lack of cognitive skills. An *inability* to do a task is less of a problem than keeping a person motivated enough to show up regularly for work. Attitudes towards school are significant determinants of school achievement.

(*a*) The first step in improving affective evaluation is to do a better job of specifying our objectives in behavioural terms, *i.e.*, to formulate specifications of a given affective objective.

(*b*) Mager (1968) suggested that we should talk about "moving toward (or approach) responses" and "moving away from (or avoidance) responses" instead of discussing about the value of positive and negative attitudes. A teacher should note every event that leads him to believe that the student has a favourable attitude towards his class. From such events we can infer his other attitudes.

(*c*) The techniques of observations, anecdotal records, sociograms and standardised inventories are helpful in measuring affective objectives. Absentee rate, dropouts, tardiness, size of elective classes, amount of extra homework, conversations in the classroom, feedback from parents are all examples of procedures that allow one to obtain measures of affective objectives. When consciously and conscientiously used, they can be quite effective and fruitful.

In short, if education is effective, the student will behave differently from the way he did before he went to school ; for education itself is a process which brings about desirable changes in the pupil's behaviour in all its aspects, namely, cognitive, affective and psychomotor skills.

Evaluate Yourself

1. Why is the role of objectives in education a controversial topic ?
2. What is an objective ? Explain it with the help of a diagram.
3. Differentiate "aim" from "objective".
4. Illustrate some aims and some objectives in full statements.
5. Why do we have objectives ?
6. Why should we state objectives ?
7. What are the different sources of objectives ? Explain, with suitable examples.
8. Explain the phrase : "Taxonomy of educational objectives".
9. State and explain the various terms of taxonomy in (*a*) the cognitive domain ; (*b*) the affective domain ; and (*c*) the psychomotor domain.
10. Explain how texonomies help us in evaluation.
11. Classify objectives on the following basis :
    (*a*) Ability ; (*b*) Time ; (*c*) Nature of achievement ; (*d*) Behaviour.
12. Write an essay (not more than 500 words) on : Cognitive and Affective Evaluation.
13. Give your suggestions for improving affective evaluation.
14. Comment on :
    (*a*) Educational aims cannot be fully achieved only through the school programme.

(*b*) Aims are directions in education.

(*c*) For the classroom teacher, objectives are more important than educational aims.

(*d*) The classification of objectives in a particular group emphasises the dominance of objectives in that group rather than the total exclusion of other objectives from the classified group.

(*e*) The classroom teacher tries to achieve his objectives only in the cognitive domain.

(*f*) Objectives in the affective domain are given a stepmotherly treatment in schools.

15. State whether the following statements are true or false :

(*a*) The school programme can fully achieve educational aims.

(*b*) Aims originate from objectives.

(*c*) Educational aims help the teacher in his day-to-day work.

(*d*) There is a circular relationship between the objectives, the teaching-learning process and evaluation.

(*e*) The needs of the state become a source of the objectives of education.

(*f*) The cognitive domain includes those objectives which deal with attitudes, values, interest and appreciation.

(*g*) The psychomotor domain includes those objectives which deal with manual and motor skills.

(*h*) Taxonomies provide a basis for a precise comparison of two curricula, syllabi or courses.

(*i*) Taxonomies do not increase the validity of the testing procedure.

(*j*) If cognitive objectives are attained, there will be a corresponding change in the appropriate affective behaviour.

16. Classify the following statements into behavioural and non-behavioural objectives :

(*a*) The pupil divides 3-digit numbers by 2-digit numbers.

(*b*) The pupil develops his skill in reading a table.

(*c*) The pupil compares the properties of compounds and mixtures.

(*d*) The pupil acquires a knowledge of the new words in a given passage.

(*e*) The pupil defines an "adjective".

(*f*) The pupil draws the diagram showing the organs of the digestive system in human beings.

(*g*) The pupil appreciates a given Hindi poem.

(*h*) The pupil solves a given rider based on the properties of parallel lines.

(*i*) The pupil recalls the names of Asian rivers.

(*j*) The pupil analyses the collected data.

17. How can the objectives of evaluation be classified ? Write down the classes and enumerate the sources of different objectives of education. Write down the hierarchy of development of any one objective from area of objectives mentioned above.

4

Communicating Objectives

4.1. Introduction

There are different points of view concerning the best way of communicating educational objectives. Some of these are :

- (*a*) Whether one should state immediate or ultimate objectives or not.
- (*b*) What should be the level of specificity ?
- (*c*) Whether the objectives should focus attention on learning activities or the learner.
- (*d*) Whether the objectives should be behavioural or non-behavioural.
- (*e*) Whether they should be teacher-focussed or learner-focussed.

The truth is that there is no single best way to state objectives, for much depends on whom one is communicating with and the purpose of the communication. For example, objectives should be stated in one way for the purpose of helping plan learning activities (instructional strategies) and in another way for informing parents.

In this book, we are primarily interested in how objectives should be stated for evaluation purposes, which certainly include the planning of learning activities and testing procedures.

4.2. How to State Objectives

One of the biggest controversies in recent years about the communication of objectives has been on whether these objectives should be stated in behavioural terms. As we have already seen, a behavioural objective is one that specifies what the learner will be *doing* when we evaluate whether or not he has attained the objective. The behavioural objectives use action verbs, whereas non-behavioural objectives do not. Behavioural objectives tend to be more specific than non-behavioural ones, and that is why behavioural objectives are generally known as *specific objectives* or *specifications.*

Hence, when we use the term "objectives," we refer to "non-behavioural objectives" and when the word "specification" is used, it refers to "behavioural objectives" or "specific objectives."

Some of the criteria for writing a statement of an objective or a specification are given below. These criteria are the same for both, except that objectives contain non-action (non-behavioural) verbs, while specifications contain action (behavioural) verbs. As a result, a specification indicates the change of behaviour that is observable and measurable, while an objective indicates no change of behaviour.

4.3. Criteria for Writing Statements of Objectives

Here, as we have already agreed, the term *objectives* means *non-behavioural objectives*.

1. As the term *non-behavioural objectives* suggests, the statement of an objective should contain a non-action verb, *e.g.*,

(*i*) The pupil *acquires knowledge* of the names of the rivers in India.

(*ii*) The pupil *develops his skill* in handling mathematical instruments.

Here, the verbs "to acquire," to develop" are non-action verbs. The statement should be in the form of inner-development or of a passive aspect of the mental activity, which cannot be observed or measured.

2. The statement of an objective should indicate a worthwhile objective. For example, looking to the age and physiological and psychological needs, abilities, etc., of primary school children, the objective—such as "to prepare scientists" or "to prepare mathematicians"—are not worthwhile. This is beyond the scope of the primary school children. Similarly, for secondary school students, such an objective as "to develop a skill in drawing a line" is not worthwhile. At this stage, worthwhile objective may be : "The pupil develops his skill in drawing triangles."

3. The statement of objectives should be related to the human ability which can be developed or achieved with the help of education. Consider the objective :

"The pupil develops the power of oral expression."

There are certain human abilities and qualities which are innate, inborn and cannot be changed with the help of education. In schools, is it possible to change the colour of one's skin ? Is it possible to change the features of the face ? Is it possible to improve intelligence beyond certain limit ? In short, "To change the colour of the skin," etc. should not be a statement of objectives.

4. The statement should also mention the subject matter area (content) through which a particular ability is to be developed; that is, along with the area the development of ability, an appropriate subject matter area should also be mentioned. For example,

Do not write : (*i*) The pupil acquires knowledge.

(*ii*) The pupil develops his skill in speaking.

Better write : (*i*) The pupil acquires knowledge of the currents of the Atlantic ocean.

(*ii*) The pupils develops his skill in speaking Hindi.

The statement of an objective should meet the common purpose of the concept of evaluation,. which is to help educationists in general and teachers in particular. Unless the subject matter area is known to the teacher, he may not be in a position to organise learning activities and ultimately to realise or attain his objectives.

5. The statement of objectives should be in the form of student's achievement and not in the form of the teacher's intention. For example,

Do not write : (*i*) To develop a scientific attitude among students.

(*ii*) To develop a mathematical outlook among students.

Better write : (*i*) The pupil develops a scientific attitude.

(*ii*) The pupil develops a mathematical outlook.

A good system of education has to be "child-centred." Again, learning is more important than teaching, and therefore a teacher's work should be rated not on the basis of his teaching effort, but on the basis of the learner's performance. The teacher should be evaluated on the basis of the extent to which he has succeeded in changing the behaviour of his students in the desired direction. To make him aware that not his intention but the learner's achievement is more important, the statement should be in the form of the student's achievement.

6. The statement of objective should be written in the form of the achievement of every single student and not in the form of the achievement of a group of students. For example,

Do not write : (*i*) The class applies its understanding w.r.t. the congruent trian gles in new situations.

(*ii*) The pupils develop their skill in handling scientific apparatus.

Better write : (*i*) The pupil applies his understanding w.r.t. the congruent triangles in new situations.

(*ii*) The pupil develops his skill in handling scientific apparatus.

We know that the teacher teaches the whole class, which consists of below average, average and above average students. He should not drag the class along with a few above-average or gifted students. Usually, the below-average, *i.e.*, slow learners, are to be better taken care of. To bring this awareness to the teacher, the statement is in the form of every single pupil. This will persuade the teacher to pay individual attention to his students.

7. The statement of objectives should contain only one ability to be developed or achieved or modified. For example,

Do not write : The pupil acquires his knowledge and applies his understanding, of the circulatory system in human organism.

Better write : (*i*) The pupil acquires knowledge of various organs taking part in the circulatory system in human organism.

(*ii*) The pupil applies his knowledge and understanding of the circulatory system in a human organism in new situations.

4.4. Criteria for Writing the Statement of Specifications (Behavioural Objectives)

By specification we mean behavioural objective or specific objective.

1. The statement of specification should contain an action verb. For example,

(*i*) The pupil *solves* the given example on profit and loss.

(*ii*) The pupil *uses* new words in his own sentences.

"To solve," "to use," "to compare," "to describe," "to explain," etc., are action verbs. The statement should be in the form of an overt activity or a behavioural outcome which is observable and measurable. This ultimately increases objectivity in evaluation. The statement should indicate clearly the behaviour as an expected outcome so that the teacher can organise his learning activities accordingly, which may prove more effective, fruitful and meaningful. [Also refer to 4.3 (1)].

2. The statement of specification should contain two parts :

(*a*) The modification part, which includes the pupil's expected behaviour ; and

(*b*) The content part, which includes the subject matter area, *i.e.* content through which behaviour is to be changed or modified. For example,

Do not write : (*i*) The pupil explains.

(*ii*) The pupil points out.

Better write : (*i*) The pupil explains the causes of an earthquake.

(*ii*) The pupil points out the suitability or otherwise of figures of speech in a given passage.

Both these parts will enable the teacher to organise learning activities during the teaching-learning process. Ultimately, he will be able to evaluate his students more effectively. [Also refer to 4.3 (4).]

3. The statement of specification should indicate a worthwhile specification. Consider the following specification :

"The pupil *criticises* the policy of Lord Curzon". Is this specification worthwhile for a pupil studying in Std. VII ? The worthwhile specification for this standard may be : "The pupil *describes* the policy of Lord Curzon." Let us consider the specification :

"The pupil draws a line of 5 cm. length."

Is this specification worthwhile for a pupil studying in Std. X ? For this standard, the worthwhile specification may be : "The pupil draws a triangle if three medians are given." [Also refer to 4.3 (2).]

4. The statement of specification should be in the form of the students' achievement and not in the form of the teacher's intentions. For example,

Do not write : (*i*) To compare symmetry with similarity.

(*ii*) To summarise the viewpoints given in a passage in Marathi.

Better write : (*i*) The pupil compares symmetry with similarity.

(*ii*) The pupil summarises the viewpoints given in a passage in Marathi.

[For reason refer to 4.3 (5).]

5. The statement of specification should be written in the form of the achievement of every single student and not in the form of the achievement of a group of students. For example,

Do not write : (*i*) The pupils define the "temperate climate."

(*ii*) The class illustrates the three types of levers.

Better write : (*i*) The pupil defines, the "temperate climate."

(*ii*) The pupil illustrates the three types of levers.

[For reason refer 4.3 (6).]

6. The statement of specification should contain only one behaviour to be developed or achieved or modified. For example,

Do not write : The pupil cites examples of parallel lines and differentiates between parallel lines and skew lines.

Better write : (*i*) The pupil cites examples of parallel lines.

(*ii*) The pupil differentiates between parallel lines and skew lines.

4.5. Degree of Specificity

One of the controversies in this area of evaluation is : To what extent should the behavioural objective (*i.e.*, specific objective or specification) be specific ? Advocates of behavioural objectives often want the objectives to be stated very specifically, even to the point of detailing what *conditions* must exist and what *standard* is to be expected while the behaviour is being performed, and of specifiying the *criteria* that must be met in order to conclude that the objective has been realised satisfactorily. For example, a behaviourally worded specification may read as follows :

1. The pupil performs arithmetic manipulations.
2. The pupil computes square roots.
3. The pupil computes the square root of 125.
4. The pupil computes the square root of 125 without using tables, slides rules or any other mechanical device, within 60 seconds and is accurate to two decimal places.

In the first three statements, no condition has been mentioned, while in the last statement, two conditions and a standard have been mentioned. Some educators feel that it is necessary to specify as much detail as is presented in 4, in order to plan learning activities.

Study the following specifications :

1. Given two altitudes and a base, the pupil accurately draws a triangle within 5 minutes.

Here, the specification contains :

(*a*) an action verb (draws) ;

(*b*) conditions (given two altitudes and a base, and within 5 mts.) ; and

(*c*) standard (accurately).

2. The pupil points out Bombay on the given world map.

Here, (*a*) "points out" is the action verb ;

(*b*) "on the world map" is the condition.

3. The pupil recites a poem with proper rhythm.

Here, (*a*) "recites" is the action verb ;

(*b*) "with proper rhythm" is the standard.

4. The pupil writes a story, after discussion, in a legible hand, covering all the points.

Here, (*a*) "writes' is the action verb ;

(*b*) "after discussion" is the condition ;

(*c*) "in a legible hand" and "covering all the points" are standards.

5. The pupil converts 50°C into the Fahrenheit scale by using a method which does not make use of the formula.

Here, (*a*) "converts" is the action verb ;

(*b*) "by using a method which does not make use of the formula" is the condition.

Thus, besides specifying the behaviour or performance of the learner, it is often helpful to specify the conditions that will be imposed upon him while he is demonstrating his ability to perform the objective.

It is one thing to find out a square root with the help of an electronic calculator and quite another to do it by hand.

Some advocates of behavioural objectives suggest that a criterion, or standard, by which behaviour is evaluated, should be specified. This is clearly necessary if by "standard" one means advance preparation of the answer to a test question or a criterion that will be used in evaluation. Usually, there are *degrees* of performance. It is not particularly wise to think of an objective as being either met or not met. More often than not, the *degree* to which it has been achieved is the information derived.

4.6. To Word Specific Objectives

Although there are certain techniques of wording objectives in order to make them behavioural, the major problem in writing them arises out of the fact that teachers have not clearly spelt out for themselves the behaviours which are reasonable indicants of their non-behaviourally stated objectives. To write objectives that can be reasonably evaluated requires considerable knowledge about (*a*) the subject matter that is taught and (*b*) about the change in behaviour one hopes to bring about among students as a result of an instructional sequence.

It is certainly more difficult to word objectives behaviourally in some areas than in others. Whenever an objective is from the affective domain, it is particularly difficult to speify it behaviourally. Gronlund (1970, p. 6) suggested that stating and writing objectives are a two-step process :

1. We should state the instructional objectives as *general* learning outcomes. For these statements, non-action

verbs such as "applies," "comprehends," and "understand" are permissible.

2. We should list under each instructional objective a representative sample of the *specific types of explicit behaviour* which indicate the attainment of the objective, *i.e.* that which describes the terminal behaviour which pupils are to demonstrate when they have achieved the objective.

As a partial help for teachers who recognise the need for behavioural objectives, but who have neither the time nor the talent to develop a comprehensive list of their own, the list below may be helpful.

Table : List of functional, behavioural, action verbs :

Abbreviate
Accent
Act
Add
Aid
Alphabetise
Alter
Analyse
Answer
Apply
Appraise
Arrange
Articulate
Ask
Attempt

Bat
Begin
Bend
Bisect
Blow
Bring
Brush
Build

Calibrate
Capitalise
Categorise
Change
Chart
Check
Choose
Circle
Cite
Clarify
Classify
Clean
Clear
Close
Collect
Colour
Combine
Communicate
Compare
Compile
Complete
Compliment
Compose
Compute
Conclude
Connect
Construct
Contrast
Contribute
Convert
Co-operate
Copy
Correct
Count
Cover
Criticize
Cut

Decide
Decrease
Deduce
Defend
Define
Demonstrate
Derive
Describe
Design

Designate
Detect
Determine
Diagram
Differentiate
Disagree
Discover
Discriminate
Discuss
Display
Dissect
Distinguish
Distribute
Divide
Dot
Draw
Drill
Drop

Empty
Erase
Estimate
Evaluate
Expand
Explain
Express
Extend
Extract
Extrapolate
Fasten
Fill
Find
Finish
Fit
Fix
Fold
Form
Formulate
Frame

Gather
Generalise
Get
Give
Graph
Group
Guide

Handle
Harmonize
Heat
Hit
Hold
Hook

Identify
Illustrate
Include
Increase
Indicate
Induce
Infer
Inform
Insert
Integrate
Interpolate
Interprete

Join

Label
Lenghthen
Lift
Light
Limit
List
Locate
Look

Make
Manipulate
Map
Mark
Match
Measure
Melt
Mend
Mix
Modify
Mold
Multiply

Name
Narrate
Note
Number

Offer
Omit
Open
Operate
Order
Organise
Outline

Pack
Paint
Paraphrase
Participate
Paste
Pay
Perform
Pick
Pin
Place
Plan
Plot
Point
Pour
Predict
Prepare
Present
Press
Produce
Pronounce
Propose
Prove
Provide
Punctuate
Put

Question
Quote

Raise
React
Read
Rearrange
Recite
Recombine
Reconstruct
Record
Reduce
Regroup
Relate
Remove
Rename
Reorganise
Re-order
Repeat
Rephrase
Replace
Report
Reproduce
Reset
Respond
Restate
Restructure
Retell
Revise
Rewrite
Roll
Rub

Say
Search
Select
Separate

Serve
Set
Shake
Share
Shorten
Show
Sign
Signify
Simplify
Sign
Sketch
Slide
Smooth
Solve

Scrt
Speak
Specify
Spell
Square
State
Stick
Stir
Substitute
Subtract
Suggest
Summarize
Supply
Support

Syllabicate
Synthesize
Systematize

Tabulate
Take
Tally
Talk
Tell
Trace
Transfer
Translate
Try
Type

Underline
Use

Vary
Verbalize
Verify
Volunteer

Watch
Weigh
Work
Write

4.7. A Word of Caution

When we state objectives behaviourally, we do not provide a panacea for existing weaknesses and limitations of educational evaluation. The following are the reasons :

(*a*) The list of objectives and specifications will always be incomplete.

(*b*) There will be unanticipated and/or unmeasurable learning outcomes and these, too, should be evaluated.

(*c*) While in principle every specification is measurable, in practice it is not so.

Teachers are expected to be alert enough to recognise unanticipated and/or unmeasurable outcomes and to try to evaluate as many of these as possible. Obviously, a fair number of outcomes cannot be measured via the traditional paper-pencil achievement-tests ; but by employing a variety of measurement techniques such as controlled observation, sociometric devices, interest and attitude inventories, etc., many of the outcomes considered unmeasurable can be measured.

It is one of the criteria of good teaching that the teacher gets as few *unanticipated and/or unmeasurable outcomes as possible.* If he carefully considers the possible outcomes of instructional programme, there should *not* be a great many unanticipated outcomes. If there are too many of these, it many well indicate that insufficient thought has gone into specifying objectives and planning learning activities and evaluation procedures.

Evaluate Yourself

1. What do you mean by behavioural and non-behavioural objectives ?

2. What are the criteria for writing the statement of objectives (general, non-behavioural) ? Give an illustration of each.
3. What are the criteria for writing the statement of specifications (specific objectives or behavioural objectives) ? Give an illustration of each.
4. Give at least ten behavioural action verbs.
5. Comment : "Stating objectives behaviourally is not a penacea for existing weaknesses and limitations of educational evaluation."
6. In each of the following specifications, find out an action verb, condition(s), if any, and standard(s), if any :
   - (*i*) The pupil estimates the length of a given segment in centimetres.
   - (*ii*) The pupil narrates a story, if points are given, with reasonable pauses and with proper speed.
   - (*iii*) The pupil predicts the climate of Canada, if its distance from the equator is given.
   - (*iv*) The pupil selects chemicals to prepare H_2 in the laboratory.
   - (*v*) The pupil revises his belief regarding British Rule in India when additional, new and reliable information is given to him.
   - (*vi*) The pupil organises his ideas of Jainism, using appropriate idioms.
   - (*vii*) The pupil locates the places of historical importances on the given map of Gujarat.
   - (*viii*) The pupil recognises the objects if proper words are given and words if objects are given to him.
   - (*ix*) The pupil draws graphs if linear equations are given to him.
   - (*x*) The pupil writes a letter, with correct punctuation in ten minutes.

5

Objectives and Specifications

5.1. Introduction

We have already discussed the taxonomies of educational objectives. The taxonomies of objectives help us to state instructional objectives of various school subjects. We have also seen that the term *objectives* means *general objectives* or *non-behavioural objectives*. The statement of an objective contains a non-action verb. Too often, objectives are expressed in vague generalities. For example,

To develop effective citizenship.

To develop critical thinking ability.

These objectives, however, are too vague for the teacher. They should be specific and must be expressed in behavioural terms. Vague, general objectives often do not offer an adequate enough direction to the teacher. As a result, he cannot prepare and organise appropriate learning activities for his pupils. Hence the need for specifications. We have also discussed that the term *specifications* means *specific objectives* or *behavioural objectives*. The statement of a specification contains an action verb. A good rule-of-thumb in writing specifications is to ask yourself : "Can my student do these things ?" For example, a class teacher gets the following answers to the above question :

My pupil,

1. explains how a steam-engine works ;
2. changes Fahrenheit temperature to Centigrade one ;
3. labels the organs of the digestive system ;
4. reads the longitude and latitude of a given place on the map ;
5. gives the past perfect tense of specified verbs ;
6. describes the political policy of Shivaji ;
7. quotes the Queen's proclamation of 1857 ;
8. draws a right-angled triangle ;

9. discriminates among the lenses as having more or less focal length ; and
10. criticises the policy of Lord Curzon.

It matters little if specification 4 involves a skill, specification 7 concerns memory (recall) or specification 1 measures understanding. What does matter is that each of these specifications is very precise, observable and measurable. With specifications phrased or expressed in the right manner, the teacher knows—

(*a*) What to teach (content-teaching points) ;

(*b*) How to teach (learning activities to be organised) ; and

(*c*) What the pupil is to be tested for (evaluation procedure).

In the following pages, an attempt has been made to remove one of the major deficiencies in the evaluation process resulting from inadequate attention being paid to the expression of instructional objectives in terms of specifications.

5.2. Specifications and Learning Outcomes

What occurs as a *result* of learning experience is termed as the *learning outcome*, while a stated desirable outcome *before* the students undergo a learning experience is termed as *specification*.

Consider the statement : The pupil draws a circle, neatly and accurately.

Here the statement serves a double purpose :

1. On the one hand, it states a desirable outcome *before* the students undergo a learning experience. This means that the statement shows a specification.

2. On the other hand, the statement states what behavioural change one would observe as a result of the learning experience. This means that the statement shows a learning outcome.

5.3. The statements of specifications or learning outcomes may run into hundreds, but with the help of taxonomies, one may classify them under a relatively small number of headings. We shall consider the following headings from the taxonomies.

Objectives from Cognitive Domain

1. Knowledge : The pupil acquires a knowledge of...
2. Understanding : The pupil develops an understanding of...
3. Comprehension : The pupil comprehends...
4. Application : The pupil applies his knowledge and understanding of......to new and unfamiliar situations.

Objectives from Psychomotor Domain

5. Skill : The pupil develops his skill in...

This may vary from subject to subject. For example,

(*i*) Laboratory skills : (*a*) skill in the process of performance.

(*b*) skill in the product of performance.

(*ii*) Communication skills such as conversation, reading, writing.

(*iii*) Computational skills.

(*iv*) Work skills.

(*v*) Study skills ; etc.

Objectives from Affective Domain

6. Interest : The pupil develops an interest in...

7. Attitude : The pupil develops a positive attitude.

(It may be social attitude or scientific attitude.)

8. Appreciation : The pupil develops an appreciation of...

OBJECTIVES OF FIRST LANGUAGE (*Higher Level*)

1. The pupil acquires a *knowledge* of the basic elements of the language, new words, figures of speech, metres, idioms, maxims, forms and style.

Specifications

(*i*) The pupil *recognises*...the basic elements of the language. For example,

(*a*) grammatical structures (noun, verb, adjective, adverb, pronoun, preposition, conjunction, articles, tenses, anomalous finite, irregular plurals, propositional phrases, verbals, comparatives, etc.) ;

(*b*) word order ;

(*c*) spelling (hard spots in words) ;

(*d*) punctuation ;

(*e*) the objects when words are given and words when objects are given ;

(*f*) figures of speech, metres, idioms, prosody, maxims, etc.

(*ii*) The pupil *recalls*...the basic elements of the language.

(*a*) to (*f*) : as above :

(*b*) the forms and style ;

(*c*) the definitions of the concepts of grammatical structures ;

(*d*) textual content ; *e.g.*, authors, topics, events, ideas, mood ;

(*e*) pronunciation, stress, intonation ;

(*f*) rules of orthography ; and

(*g*) prefixes and suffixes.

2. The pupil *comprehends* (develops understanding) of the theme, basic elements of the language, etc.,...

(*a*) while listening to the teacher (or a radio news broadcast or a news bulletin on TV) ;

(*b*) while conversation takes place ;

(*c*) while reading loudly by himself ; and

(*d*) while reading silently by himself.

In all the cases, it is quite impossible to observe and measure the behaviour of the child. Even by observing his facial expressions and the direction of his eye-movements, etc., evaluation will be highly subjective, for the child may very easily cheat. It is not during the listening/reading process, but after that, that the expected learning outcomes can be checked.

Specifications

After listening/reading is over or while the conversation is going on,

(*i*) The pupil *tells*...

(*a*) the meanings of words, phrases, sentences ;

(*b*) the theme in his own words ;

(*c*) the synonyms and antonyms of the words.

(*ii*) The pupil *narrates*...

(*a*) the theme in his own words ;

(*b*) the sequence of ideas ;

(*c*) the directions given by the teacher.

(*iii*) The pupil *uses*...

(*a*) basic elements of the language correctly, according to the context ;

(*b*) the new words, proverbs, maxims, figures of speech, idioms, dictums, parts of speech, etc., in his own sentences ;

(*c*) dictionaries.

(*iv*) The pupil *explains*...

(*a*) the ideas implied in the speech ;

- (*b*) the meanings of the words, phrases, sentences, dictums, figures of speech, idioms, maxims, proverbs ;
- (*c*) the sequence of ideas, facts, events ;
- (*d*) the suitability of the title ;
- (*e*) the rules of orthography.

(*v*) The pupil *locates*...

- (*a*) key words, phrases, etc., in a given passage or poem ;
- (*b*) the significant details ; *e.g.*, maxims, idioms, metres ;
- (*c*) orthographical errors.

(*vi*) The pupil *finds out*...

- (*a*) the central idea of a given passage or poem ;
- (*b*) the new verbs, proverbs, maxims, prefixes, suffixes ;
- (*c*) answers of the questions based on the text or on an unseen passage or poem.

(*vii*) The pupil *underlines*...

- (*a*) new words or phrases ;
- (*b*) significant details such as clauses, degrees, connectives, etc.

(*viii*) The pupil *draws inferences* from the theme in a given passage or poem.

(*ix*) The pupil *describes*...

- (*a*) historical, mythological, social, moral references ;
- (*b*) style and form of a given paragraph or poem : *e.g.* a sonnet.

(*x*) The pupil *summarises*...
author's viewpoints.

(*xi*) The pupil *selects*...
proper words, sentences, idioms, proverbs, etc., with reference to the context.

(*xii*) The pupil *establishes a relationship*...

- (*a*) between thoughts, ideas, meanings, pictures, actions ;
- (*b*) of the words in word-building.

(*xiii*) The pupil *gives example*...

- (*a*) of kinds of nouns, adjectives and other parts of speech ;
- (*b*) of the thought, idea, events, etc., given in a passage or poem ;
- (*c*) of different styles and forms of the language.

(*xiv*) the pupil *classifies*...

the words into different kinds of nouns, adverbs, prefixes, suffixes, etc.

(*xv*) The pupil *corrects*...

(*a*) incorrect spellings, words and so on ;

(*b*) incorrect idioms, proverbs and so on ;

(*c*) the usage of verbs, tenses, etc.

(*xvi*) The pupil *compares*...

the thoughts, ideas, events, situations, in two passages or poems.

(*xvii*) The pupil *analyses*...

(*a*) the given compound sentence or complex sentence into various clauses ;

(*b*) the sentence into parts of speech ;

(*c*) compound words.

(*xviii*) The pupil *forms*...

(*a*) nouns from adjectives ;

(*b*) adjectives from adverbs, etc.

(*xix*) The pupil *identifies*...

(*a*) various kinds of sentences ;

(*b*) various figures of speech, idioms, proverbs, etc., in a passage or poem.

(*xx*) The pupil *transforms*...

(*a*) a sentence of a given pattern into another, *e.g.*, from active voice to passive voice ;

(*b*) a word by using a prefix or a suffix.

(*xxi*) The pupil *defines*...

the style and form of a given para or poem, *e.g.*, What is a lyric ? What is a metaphor ? What is alliteration ?

(*xxii*) The pupil *detects errors*...

in the style and form of a given piece of literature, *e.g.*,

(*a*) the poem is unncessarily too long ;

(*b*) a particular metre is inappropriate for producing a feeling of love or anger or pity ; etc.

(*xxiii*) The pupil *rectifies errors*...

in the style and form of a given piece of literature, *e.g.*, he rectifies the errors shown in (*xxii*).

3. The pupil develops a *skill in the oral expression* of the ideas, descriptions, maxims, epigramatic sentences, rhythm, figures of speech, idioms, etc.

Specifications

(*i*) The pupil *reproduces orally*...

- (*a*) ideas, sentences, maxims, etc. with guidelines (controlled expression), *e.g.*, telling a story if points are given ;
- (*b*) the ideas, sentences, maxims, etc., without guidelines (free expression), *e.g.*, adding some points on his own to the points given for telling a story or talking about an essay, etc.

(*ii*) The pupil *describes* (*narrates*)...

- (*a*) a language with correct accent (emphasis), pronunciation, intonation, punctuation ;
- (*b*) with reasonable pauses :
- (*c*) with proper speed ;
- (*d*) with a reasonable flow of speech ;
- (*e*) with a proper modulation of voice and facial expression ;
- (*f*) his ideas in an original manner (with imagination), etc.

(*iii*) The pupil *organises his ideas*...

- (*a*) in a proper logical sequence ;
- (*b*) by using appropriate style and form ;
- (*c*) by using appropriate words, sentences, maxims, dictums, proverbs, figures of speech, idioms, etc.

(*iv*) The pupil *imitates*...

- (*a*) the pronunciations, accent, intonation, modulation of voice, etc., correctly ;
- (*b*) the sentence patterns ;
- (*c*) the form and style, etc.

(*v*) The pupil *recites*...

songs and poems with proper rhythm.

(*vi*) The pupil *dramatises*...

his speech with proper gestures, actions.

(*vii*) The pupil *explains* orally...

the given dictum, proverb, idiom, figure of speech, metre, etc., in proper language.

4. The pupil develops his *skill in written expression* of the ideas, descriptions, maxims, idioms, figures of speech, proverbs, etc.

Specifications

(*i*) The pupil *writes*...

his ideas, explanations, descriptions, stories, letters, essays, etc....

- (*a*) in correct idiomatic language ;
- (*b*) by using maxims and figures of speech ;
- (*c*) with proper speed ;
- (*d*) with correct punctuation ;
- (*e*) in a legible hand ;
- (*f*) neatly ;
- (*g*) by spacing out words, letters, etc., properly.

(*ii*) The pupil *transcribes* (copies)...

the letters, words, phrases, sentences, correctly with an appropriate proportion and size of the letters and with proper spacing.

(*iii*) The pupil *takes dictation*...

- (*a*) with correct spelling ;
- (b) with correct punctuation ;
- (*c*) in correct language ;
- (*d*) in a legible hand ;
- (*e*) neatly ;
- (*f*) by spacing out words, letters, etc., properly ;
- (*g*) with appropriate proportion and size of the letters ;
- (*h*) according to suggested forms and style.

(*iv*) The pupil *uses*...

- (*a*) a varied sentence pattern ;
- (*b*) appropriate words and phrases, figures of speech, idioms ;
- (*c*) various marks of punctuation correctly ;
- (*d*) various forms and style of reporting.

(*v*) The pupil *organises*...

ideas, facts,

- (*a*) in a proper logical sequence ;
- (*b*) by using appropriate idioms and figures of speech ;
- (*c*) by using proper forms and style.

5. The pupil develops *interest* in the mother tongue (*the first language*).

Specifications

The pupil...

(*i*) *reads* (*a*) books other than the text book ;
(*b*) daily newspaper, magazines, journals.

(*ii*) *recites* poems, couplets.

(*iii*) *makes use* of dictionaries, reference books.

(*iv*) *listens to* radio news bulletins, TV news bulletins.

(*v*) *writes* articles, reports, stories, poems, etc., for the school magazine, other magazines or newspaper.

(*vi*) *participates* in debates, dramatics, discussions, elocution competitions and other literary competitions.

(*vii*) *establishes* his personal library.

6. The pupil develops the power of *appreciation* of a good literary piece in the mother tongue.

Specifications

The pupil...

(*i*) *enjoys* (*a*) the rhythm of the poems ;
(*b*) reciting poems, verses, dictums, epigrams or passages ;
(*c*) prosody, figures of speech, etc., in a given piece of literature ;

(*ii*) *shares* the emotions expressed in a given piece ;

(*iii*) *recognises* word pictures, figures of speech, metre, rhythm, key words, grammar ;

(*iv*) *joins* the teacher in singing poems, couplets ;

(*v*) *expresses* his appreciation of
  (*a*) the form of a given piece ;
  (*b*) the style of communicating feeling and emotions, thoughts, ideas, etc.

OBJECTIVES OF SECOND LANGUAGES (*Lower Level*)

1. The pupil acquires a *knowledge* of the basic elements of a language, new words, idioms, maxims, etc.

Specifications

(*i*) The pupil *recognises*...

the basic elements of a language ; for example,

  (*a*) grammatical structures (noun, verb, adjective, adverb, pronoun, preposition, conjunction, articles, tenses, anomalous finite, irregular plurals, prepositional phrases, verbals, comparatives, etc.) ;
  (*b*) word order ;
  (*c*) spelling (hard spots in words) ;
  (*d*) punctuation ;

  - (*e*) objects when words are given and words when objects are given.

- (*ii*) The pupil *recalls...*

  the basic elements of language ; for example,
  - (*a*) grammatical structures (as above) ;
  - (*b*) word order ;
  - (*c*) sentence patterns (forms and concords) ;
  - (*d*) vocabulary (synonyms, antonyms, derivatives) ;
  - (*e*) spelling (hard spots in words) ;
  - (*f*) punctuation ;
  - (*g*) pronunciation, stress, intonation ;
  - (*h*) definitions of noun, adjective, pronoun, and other parts of speech ;
  - (*i*) textual content ; *e.g.*, authors, topics, events, ideas, mood, etc.

2. The pupil *comprehends* (develops an *understanding* of) the theme, words, phrases, structure,
   - (*a*) while listening to the teacher (or radio news broadcast or a news bulletin)on TV ;
   - (*b*) while a conversation takes place ;
   - (*c*) while reading loudly by himself ;
   - (*d*) while reading silently by himself.

It is quite impossible to observe and measure the behaviour of the child in all cases. Even when we observe his facial expressions and the direction of his eye movements, etc., our evaluation will be highly subjective, for the child may very easily cheat. It is not during the listening/reading process, but after that, that the expected learning outcomes can be checked.

Specifications

After listening/reading is over,

- (*i*) The pupil *tells...*
  - (*a*) the meanings of the words, phrases, idioms ;
  - (*b*) the theme in his own-words ;
  - (*c*) the synonyms and antonyms of the words (vocabulary).
- (*ii*) The pupil *narrates...*
  - (*a*) the theme in his mother tongue in his own words ;
  - (*b*) the sequence of ideas ;
  - (*c*) the directions given by the teacher.

(*iii*) The pupil *uses*...
  - (*a*) the structure of a sentence, words, etc., correctly according to the context ;
  - (*b*) the new words, proverbs, maxims, etc., in his sentences ;
  - (*c*) dictionary.

(*iv*) The pupil *explains*...
  - (*a*) the ideas implied in the speech ;
  - (*b*) the meanings of words, phrases, sentences, dictums, proverbs, maxims ;
  - (*c*) the sequence of ideas, facts, events ;
  - (*d*) the suitability of the title.

(*v*) The pupil *locates*...
  - (*a*) key words, phrases, etc., in a given passage or poem ;
  - (*b*) the significant details.

(*vi*) The pupil *finds out*...
  - (*a*) the central idea of a given passage or poem ;
  - (*b*) new verbs, proverbs, maxims ;
  - (*c*) answers of the questions based on the text or on an unseen passage, poem.

(*vii*) The pupil *underlines*...
  - (*a*) the new words or phrases ;
  - (*b*) the significant details.

(*viii*) The pupil *draws inferences*...
from the theme in a given passage or poem.

(*ix*) The pupil *explains*...
historical, mythological, social, moral references.

(*x*) The pupil *summarises*...
the author's viewpoints.

(*xi*) The pupil *selects*...
proper words, sentences, idioms, phrases, proverbs, etc., with reference to the context.

(*xii*) The pupil *establishes a relationship*...
  - (*a*) between thoughts, ideas, meanings, pictures, actions ;
  - (*b*) of words in word-building.

(*xiii*) The pupil *gives examples*...
  - (*a*) of kinds of nouns, adjectives, and other parts of speech ;
  - (*b*) of the thought, idea, events, etc., given in a passage or poem.

(xiv) **The pupil *classifies*...**
the words into different kinds of sentences, nouns, adverbs, and other parts of speech ;

(*xv*) The pupil *corrects*...
(*a*) the incorrect spellings, words, phrases, sentences ;
(*b*) wrong verbs, tenses, sentences, phrases.

(*xvi*) The pupil *compares*...
thoughts, ideas, events, situations in two passages or poems.

(*xvii*) The pupil *analyses*...
the given compound or complex sentences into various clauses.

(*xviii*) The pupil *makes*...
(*a*) nouns from adjectives ;
(*b*) adjectives from adverbs and other relevant parts of speech.

(*xix*) The pupil *identifies*...
various kinds of sentences ;

(*xx*) The pupil *transforms*...
a sentence from a given pattern into another ; *e.g.*, from active voice to passive voice.

3. The pupil develops his *skill in an oral expression* of ideas, descriptions, maxims, epigrammatic sentences, etc.

Specifications

(*i*) The pupil *reproduces* orally...
(*a*) ideas, sentences, maxims, etc., with guidelines (controlled expression) ; *e.g.*, by telling a story when points are given ;
(*b*) ideas, sentences, maxims, etc., without guidelines (free expression) ; *e.g.*, by adding some points on his own to the points given for telling a story.

(*ii*) The pupil *describes* (*narrates*)...
(*a*) a language with a correct accent (emphasis), pronunciation, intonation, punctuation ;
(*b*) with reasonable pauses ;
(*c*) with proper speed ;
(*d*) with a reasonable flow of speech ;
(*e*) with a proper modulation of voice and facial expression ;
(*f*) his ideas in an original manner (with imagination), etc.

(*iii*) The pupil *organises* his ideas...
   (*a*) in a proper logical sequence ;
   (*b*) using appropriate words, phrases, sentences, dictums, proverbs, etc.

(*iv*) The pupil *imitates*...
   (*a*) the pronunciations, accent, intonation, modulation of voice, etc. correctly ;
   (*b*) the sentence patterns.

(*v*) The pupil *recites*...
songs and poems with proper rhythm.

(*vi*) The pupil *dramatises*...
his speech with proper actions.

(*vii*) The pupil *explains* orally...
the given dictum or proverb in proper words.

4. The pupil develops *skill in the written expression* of ideas, descriptions, maxims, proverbs, etc.

Specifications

(*i*) The pupil *writes*...
his ideas, descriptions, explanations, proverbs, stories, letters, essays, etc.
   (*a*) in correct language ;
   (*b*) with proper speed ;
   (*c*) with correct punctuation ;
   (*d*) in a legible hand ;
   (*e*) neatly ;
   (*f*) spacing words, letters, etc. properly ;
   (*g*) according to the suggested form and style.

(*ii*) The pupil *transcribes* (*copies*)...
letters, words, phrases, sentences, correctly with an appropriate proportion and size of the letters and with proper spacing.

(*iii*) The pupil *takes dictation*...
   (*a*) with correct spelling ;
   (*b*) with correct punctuation ;
   (*c*) in a correct language ;
   (*d*) in a legible hand ;
   (*e*) neatly spacing words, letters, etc., properly ;
   (*f*) with appropriate proportion and size of letters.

(*iv*) The pupil *uses*...
  - (*a*) varied sentence patterns ;
  - (*b*) appropriate words and phrases ;
  - (*c*) various marks of punctuation correctly ;
  - (*d*) various forms of reporting.

(*v*) The pupil *organises* ideas, facts, etc....
  - (*a*) in a proper logical sequence ;
  - (*b*) by using appropriate words, phrases, sentences, figures of speech, maxims, etc.

5. The pupil develops *interest* in a second language.

Specifications

The pupil on his own,

(*i*) **reads**...
  - (*a*) books other than the text books ;
  - (*b*) daily newspapers, magazines, etc. ;

(*ii*) **recites** poems, couplets ;

(*iii*) **makes use** of dictionary.

6. The pupil develops the power of *appreciation* of a good literary piece in a second language.

Specifications

The pupil,

(*i*) **enjoys**...
  - (*a*) the rhythm of a poem ;
  - (*b*) reciting poems, dictums, passages.

(*ii*) **shares** the emotions expressed in a passage ;

(*iii*) **recognises** word pictures ;

(*iv*) **joins** the teacher in singing a poem.

OBJECTIVES OF HISTORY

(A) Class-room Instructional Objectives

1. The pupil acquires *knowledge* of facts, concepts, terms, events, phenomena ; symbols, chronology, dates, names, charts, pictures, opinions, etc., concerning the subject of history.

Specifications

(*i*) The pupil *recognises*...
  - (*a*) names, pictures and portraits of the Buddha, Gandhi, Akbar, Shivaji and others ;
  - (*b*) models and specimens of coins, relics ;

(c) location, territories and capitals of various kingdoms ; *e.g.*, Pataliputra (Magadh), Delhi (Moghul), etc.

(*ii*) The pupil *recalls*...

(*a*) names of social reformers like Raja Ram Mohan Roy ;

(*b*) names of freedom fighters such as Gandhiji, Nehru, Sardar Patel, Tilak ;

(*c*) important dates and events like the Third Battle of Panipat (1761), birth date of Ashoka (273 B.C.), the Second World War (1939) ;

(*d*) movements and episodes of history such as movement of non-cooperation, Dandi March, the episode of Jalianwala Bagh, etc.

(*iii*) The pupil *shows information*...

on maps, charts, diagrams ; *e.g.*, shows Taxila, the extent of Maratha empire, etc.

2. The pupil develops an *understanding* of concepts, ideas, problems, conventions, trends, hypotheses, principles, relationships, etc., of history.

Specifications

(*i*) The pupil *explains*...

the significance of the policy of *ahimsa*, the policy of *satyagraha*, the need for co-operative living and interdependence among groups and nations, etc.

(*ii*) The pupil *gives reasons*...

for the defeat of the Marathas in the Battle of Panipat, for the separation of Pakistan and India, for the French Revolution, etc.

(*iii*) The pupil *cites*...

the names of religious reformers like Jesus Christ, Shankaracharya, Mahavir, the Buddha, and the names of social reformers like Raja Ram Mohan Roy, and Justice Ranade.

(*iv*) The pupil *infers*...

why Ashoka embraced Buddhism, the results of the first attempt of Independence War, the conditions after World War I, etc.

(*v*) The pupil *translates*...one form of communication to another ; *e.g.*

(*a*) given fossils, states the type of the then civilisation ;

(*b*) given a map, translates data in his notebook.

(*vi*) The pupil *compares and contrasts*...

the religious policies of Ashoka and Aurangzeb, old and new Stone Age, Shankaracharya and the Buddha, old traditions and customs with new ones, joint family vs. single family system.

(*vii*) The pupil *identifies*...

(*a*) Relationships : The French Revolution and the Industrial revolution in England, Akbar's Navratna Darbar and Shivaji's Ashtapradhan Mandal, etc.

(*b*) Problems of changes in constitution, etc.

(*viii*) The pupil *detects errors* in...

(*a*) the statements such as : "Swami Vivekanand was a political leader".

(*b*) maps wherein showing wrongly the territory of a kingdom.

(*ix*) The pupil *rectifies errors* in...

(*a*) and (*b*) as above.

(*x*) The pupil *summarises*...

the reforms of Dalhousie, the teachings of the Buddha, Vardhamana, the Independence movement in India, etc.

(*xi*) The pupil *criticises*...

the policy of Lord Curzon, the Queen's proclamation, the Maratha rule, etc.

3. The pupil *applies his knowledge and understanding* to new and unfamiliar situations.

Specifications

(*i*) The pupil *predicts*...the outcome of

(*a*) constitutional changes ;

(*b*) the religious policy of Aurangzeb ;

(*c*) the death of Sardar Patel.

(*ii*) The pupil *analyses*...

the freedom struggle of 1857, the downfall of the Moghul empire, the rise of the British empire, views on non-violence in peace and war, etc.

(*iii*) The pupil *forms hypothesis*...

at British rule was a blessing to India, that the traditional joint family system was better, that Indian civilisation is the oldest one, older than that of Egypt, China and Greece, etc.

(*iv*) The pupil *verifies the hypothesis*...

by analysing the problem, collecting data, drawing inferences and generalisations ; *e.g.* take any hypothesis from the above.

(*v*) The pupil

(*a*) explains ; (*b*) gives reasons ; (*c*) illustrates ; (*d*) infers from ; (*e*) translates ; (*f*) compares and contrasts ; (*g*) identifies relationships and problems ; (*h*) detects errors ; (*i*) summarises ; (*j*) criticises historical events in the context of present-day current events, *i.e.*, in the new situations.

4. The pupil *develops practical skills* involved in the study of history.

Specifications

(*i*) The pupil *reads*...complicated maps, charts, time charts, the distance between Pataliputra and Vaishali, the extent of the empire of Ashoka, etc.

(*ii*) The pupil *prepares*...

(*a*) models of forts, pyramids ;

(*b*) tools of the old Stone Age and the new Stone Age ;

(*c*) time lines, etc.

(*iii*) The pupil *draws*...a map of India, a map of Gujarat, the boundaries of the extent of an empire, etc.

(*iv*) The pupil *locates*.. routes of invasions, places of historical importance, etc., on an outline map.

(*v*) The pupil *presents*...data in symbolic forms ; *e.g.*, crop production by pie-chart, etc.

(B) Personality Objectives

5. The pupil develops *interest* in historical as well as social phenomena and related activities.

Specifications

The pupil on his own

(*i*) **reads**...

(*a*) historical novels, dramas, books, magazines, newspapers, etc., to gather information of a social, cultural, political and economic historical nature ;

(*b*) journals of research articles on history ; *e.g.* Who built the Taj Mahal ? Was the Ramayana real historical event ?

(*c*) biographies of historical figures—Napoleon's biography ;

(*ii*) **visits** places of historical interest and importance ; *e.g.* Kutub Minar, Sanchi, Patan, Ujjain ;

(*iii*) **participates** *in such activities* as debates, in or outside the school, bearing on history ; *e.g.*, Debate on "the policies of Mohammed Taghluk" ;

(*iv*) **collects** pictures, stamps, specimens, data, coins, etc., of historical significance ; *e.g.* pictures of emperors, Gandhiji's political movement ; specimens of old coins and new coins ;

(*v*) **prepares** models, charts, maps, pictures having historical significance *e.g.* picture showing the battle at Haldighat ;

(*vi*) **contributes** exhibits concerning historical matters for a display organised in or outside the school ;

(*vii*) **writes** articles, news items, etc., on a historical subject ;

(*viii*) **prefers to see** movies, based on historical themes ; *e.g.* Malavpati Munj, Mogul-e-Azam, Rama Rajya ;

(*ix*) **prefers to watch or listen to** the programmes on historical subjects on TV, radio, etc.

6. The pupil develops a positive *attitude* towards historical and social ideas.

Specifications

(*i*) The pupil *shows*......

(*a*) a sense of healthy patriotism ;

(*b*) faith in the democratic ideals and way of life ;

(*c*) respect for the dignity and worth of the individual personality irrespective of caste, creed, and colour ;

(*d*) open-mindedness towards new ideas ;

(*e*) faith in the usefulness of international organisations and their contributions towards world-peace ;

(*f*) sympathy with people in and outside his group ;

(*g*) willingness to sacrifice his own interest in favour of that of society ;

(*h*) his preparedness in extending help to members of his community ;

(*ii*) **respects**......

(*a*) law and order ;

(*b*) conventions ;

(*c*) opinions of others ;

(*d*) research findings even though these are contrary to his belief or popular belief ;

(*e*) decisions reached on facts rather than propaganda and opinions ;

(*iii*) **accepts**......

(*a*) only those suggestions which are based on conclusions derived from historical researches ;

(*b*) social responsibilities ;

(*iv*) **expresses......**
- (*a*) his ideas with the help of historical examples ;
- (*b*) his belief in man as an agent of social change ;
- (*c*) his belief that any social problem can be solved through a democratic approach ;

(*v*) **arrives at judgements......**
after weighing all possible evidence carefully and dispassionately ;

(*vi*) **recognises......**
the contribution of other regions and people to the growth of civilisation and culture ;

(*vii*) **co-operates......**
with others in social, civil and cultural matters ;

(*viii*) **revises......**
his conclusion, belief, etc., in the light of additional or new and reliable information ;

(*ix*) **follows......**
the instructions and guidelines issued by such international organisations as the UNICEF.

7. The pupil *appreciates* the contribution of history to all the fields of knowledge and to life.

Specifications

The pupil...

(*i*) **shows** dislike of the weaknesses of our great personalities ;

(*ii*) **does not fall a prey** to hero worship ;

(*iii*) **expresses**...
- (*a*) an appreciation of past social and cultural heritage ;
- (*b*) an appreciation of the social, political and religious principles followed by great people ;
- (*c*) the qualities and virtues of our people, their life, etc., and even of our enemies ;
- (*d*) his appreciation of man's effort to conquer natural forces.

OBJECTIVES OF GEOGRAPHY

(A) Classroom Instructional Objectives

1. The pupil acquires *knowledge* of facts, concepts, terms, events, phenomena, symbols, names, charts, pictures, chronology, etc. concerning the subject matter of Geography.

Specifications

(*i*) **The pupil** *recognises...*

(*a*) the people of different States of India, Eskimos, Kirgheses ;

(*b*) India on the map of the world ;

(*c*) symbols used for dams, railways, roads ;

(*d*) different parts of a volcano in a chart or picture.

(*ii*) The pupil *recalls*...

(*a*) the names of the physical divisions of India, names of the mountains and rivers of India ;

(*b*) names of capitals, cities, etc., of the different countries ; crops and industries of various countries ;

(*c*) the symbols used in maps, charts ;

(*d*) the definitions of various terms such as isobars, isotherms, longitude, sedimentary rocks.

2. The pupil develops an *understanding* of geographical concepts, methods, conventions, hypotheses, principles, facts, trends, problems, laws, relationships, etc.

Specifications

(*i*) The pupil *cites*···

the names of countries in the equatorial region, the areas where rice is the staple food of the people.

(*ii*) The pupil *compares and contrasts*···

the climate of Nagpur and Bombay the crops of India and Pakistan, the climates of west coast of the U.S.A. and east coast of the U.S.A.

(*iii*) The pupil *classifies*···

the climatic conditions of the equatorial region in terms of temperature, rainfall, the countries according to their population density.

(*iv*) The pupil *discriminates*···

between the climatic conditions of Gujarat and Rajasthan and the industrial growth of one country and another.

(*v*) The pupil *generalises*...

(*a*) that the situation of a State has its effect on the dress food habits, philosophy of life, etc. of the people of that State. Consider Punjab, Gujarat ;

(*b*) that the ocean currents affect the business of a country.

(*vi*) The pupil *detects errors*···

(*a*) in such statements as "Kerala grows wheat", "Rice is a major crop of Uttar Pradesh ;

(*b*) in the location of cities, rivers and mountains in a given map ;

(c) in symbolising roads, dams, railways, mountains and lakes.

(vii) The pupil *rectifies errors*... in (a), (b) and (c) as above.

(viii) The pupil gives geographical reasons...

(a) for "Afghanistan has no railways", "The Arabs worship the moon", "Bombay is a good harbour", "India has a distinct monsoon."

3. The pupil *applies his knowledge and understanding* to new and unfamiliar situations and to day-to-day problems.

Specifications

(i) The pupil *analyses*...

(a) problems : *e.g.*, Why does Rajasthan get little rain ? or Why do Bengalis take rice and fish ? Why is Bombay a good sea port ?

(ii) The pupil *formulates hypothesis*...

(a) that "as Bengalis take rice as their food, they are lazy" ;

(b) that "where the Himalayas are today there was sea in bygone days."

(iii) The pupil *collects*...relevant data about a hypothesis ; *e.g.*,

(a) Does rice produce laziness ? Are Keralites, who take rice, lazy ? etc.

(b) Are the Himalayas made up of sedimentary rocks ? Do they have fossils ? Do the rocks have parallel layers ?

(iv) The pupil *selects*...

relevant data, *i.e.*, facts and principles to a particular situation ; *e.g.*, for checking the hypothesis : "U.P. has many sugar mills," he will not select data regarding the population density of the State.

(v) The pupil *judges*...

the adequacy of data, *e.g.*, for studying the population density of a State, the area of a State is an adequate information.

(vi) The pupil *verifies*...

hypothesis based on collected data.

(vii) The pupil *predicts*...

(a) the climate of Canada, applying the principle of distance from equator ;

(b) the food habits of the people if the climate of their place is known.

4. The pupil develops the *practical skills* involved in the study of Geography.

Specifications

(*i*) The pupil *draws*...
maps, charts, graphs.

(*ii*) The pupil *prepares*...
- (*a*) models, like one of a dam showing irrigation through canals and generation of hydro-electricity ;
- (*b*) charts showing rainfall, temperature, etc., of a particular place ;
- (*c*) maps of India, Asia and other places ;
- (*d*) graphs showing cropwise production, industrial growth, etc.

(*iii*) The pupil *fills in*...
the rivers, mountains, cities, etc., in an outline map.

(*iv*) The pupil *handles*...
maps and models carefully.

(*v*) The pupil *reads*...
- (*a*) the latitudes and longitudes of a given place ;
- (*b*) the contours, isobars, isotherms.

(B) Personality Objectives

5. The pupil develops an *interest* in Geographical, social phenomena and related activities.

Specifications

The pupil on his own

(*i*) **reads**...
- (*a*) novels, stories, etc., about travel from one part of the world to another ;
- (*b*) books, magazines, newspapers, etc., to gather information of a geographical nature ;
- (*c*) journals of research articles on Geography ; *e.g.* the crest of moon, the atmosphere on the Mars ;
- (*d*) biographies of explorers and geographers ;

(*ii*) **visits**...
places of interest and importance from the geographical point of view ; *e.g.*, the meteorological observatory, the nearby States and countries like Nepal, Sri Lanka ;

(*iii*) **participates**...
in activities like talks, debates, projects in or outside the school related to Geography ; *e.g.*, "Vasco da Gama discovered the sea route to India ";

(*iv*) **collects**...
pictures, stamps, specimens, photographs, data etc., of geographical significance ; *e.g.*, a picture showing coconut

trees of Kerala, etc., collection of specimens of rocks, crops ;

(*v*) **prepares...**
models, charts, maps, pictures of a geographical nature ; *e.g.*, chart showing the occurrence of seasons, a map showing the physical features of India ; etc.

(*vi*) **contributes exhibits...**
to geographical displays organised in or outside the school, *e.g.*, exhibits showing glaciers, snow, rivers ;

(*vii*) **writes...**
articles, news items, etc., pertaining to the Geography ; *e.g.*, writes on the latest information regarding the moon, air pollution ;

(*viii*) **prefers to see...**
movies based on geographical scenes ;

(*ix*) **prefers to attend...**
geographical programmes released on TV, radio ;

(*x*) **takes up hobbies...**
of a geographical nature ;

(*xi*) **meets...**
Geographists, explorers, travellers, whenever possible ;

(*xii*) **helps...**
in the maintenance of a geographical museum ;

6. The pupil develops positive *attitudes* towards geographical and social ideas.

Specifications

The pupil

(*i*) **shows...**
sympathy for the people of other States and other nations ;

(*ii*) **respects...**
(*a*) the traditions, customs, conventions, etc., of the people of other regions ;
(*b*) the research findings even though these are contrary to his belief or popular belief ;

(*iii*) **accepts...**
only those suggestions based on the conclusions derived from geographical researches ;

(*iv*) **expresses...**
(*a*) his ideas with the help of geographical examples ;
(*b*) his belief in man as an agent of social change ;

(*v*) **arrives at judgements...**
after weighing all the possible evidence carefully and dispassionately ;

(*vi*) **recognises**...
the contribution of other regions and people to the growth of civilisation ;

(*vii*) **co-operates**...
with others in social, civil and cultural matters ;

(*viii*) **revises**...
his conclusions, beliefs, etc., in the light of additional new and reliable information ;

(*ix*) **follows**...
the instructions and guidelines issued by an international organisation like the UNESCO.

7. The pupil *appreciates* the contribution of Geography to all the fields of knowledge and of life.

Specifications

The pupil

(*i*) **expresses**...
- (*a*) his appreciation of man's effort to conquer natural forces ;
- (*b*) the qualities and virtues of our people, their living conditions etc., and even of our enemies ;
- (*c*) his appreciation of the costumes and food habits of the people in different parts of the world ;
- (*d*) his appreciation of the traditions, customs, conventions, etc., of various people ;
- (*e*) his pride in man's heritage ;

(*ii*) **recognises**...
- (*a*) the contribution made by explorers, travellers, scientists, to our knowledge of Geography ;
- (*b*) the work of international agencies in this field.

OBJECTIVES OF MATHEMATICS

(A) Classroom Instructional Objectives

1. The pupil acquires a *knowledge* of mathematical terms, concepts, facts, symbols, definitions, laws.

Specifications

(*i*) The pupil *recognises*...
the names of the parts of a triangle, pythagorian law, the diagram of a circle, definition of an angle, the members of a set, commutative property.

(*ii*) The pupil *recalls*...
- (*a*) definitions such as finite set, [illegible]rallel lines, similarity, congruence, equation, open se[illegible]ce ;

   (*b*) the names of concepts such as L.C.M., set number line, plane, betweenness ;

   (*c*) the names of parts of a triangle, polygon, polyhedron ;

   (*d*) the names of properties like commutative, associative, and properties of adjacent angles ; etc.

2. The pupil develops an *understanding* of mathematical terms, facts, definitions, concepts, properties, laws, relationships, theories, procedures.

Specifications

(*i*) The pupil *discriminates between*...
   (*a*) an acute angle and an obtuse angle ;
   (*b*) a linear equation and a quadratic one ;
   (*c*) a finite set and infinite one ;
   (*d*) a prism and a cylinder.

(*ii*) The pupil *sees a relationship*...
   (*a*) between similarity and symmetry ;
   (*b*) between indices and logarithms ;
   (*c*) between sin θ and cos θ.

(*iii*) The pupil *selects*...
   (*a*) appropriate instruments to draw a triangle of a given measure ;
   (*b*) an appropriate method to factorise a given expression ;
   (*c*) an appropriate property to solve an example.

(*iv*) The pupil *compares*...
   (*a*) parallel lines and skew lines ;
   (*b*) equal sets and equivalent sets ;
   (*c*) the properties of natural numbers with those of real numbers.

(*v*) The pupil *classifies*...
   (*a*) the given points into interior points and exterior points with respect to a given triangle ;
   (*b*) the given sets into convex sets and non-convex sets ;
   (*c*) the angles inso alternate angles, corresponding angles and interior angles.

(*vi*) The pupil *cites illustrations*...
   (*a*) of symmetric figures ;
   (*b*) of open sentences ;

- (*c*) of equal sets ;
- (*d*) of a binomial.

(*vii*) The pupil *detects* errors...

- (*a*) in statements like "similar figures are always congruent ";
- (*b*) in wrongly presented venn diagrams ;
- (*c*) in formulae ; *e.g.*, area of a rectangle=1/b ;
- (*d*) in a given example ; *e.g.*, factorise : $(x-y)^3$

(*viii*) The pupil *rectifies* errors...

in a given statement, diagram, formula, example ; *e.g.*, Area of a rectangle$=1+b$.

(*ix*) The pupil *generalises*...

- (*a*) that profit=S.P.—C.P.
- (*b*) that the sum of the measures of the angles of a triangle is 180 ;
- (*c*) that the modulus of a number is always a positive number.

(*x*) The pupil *verifies*...

- (*a*) the answer by substituting the values in a given problem or equation ;
- (*b*) the answer by drawing a graph.

(*xi*) The pupil *uses* an appropriate method...

- (*a*) to work out a problem ;
- (*b*) to solve a rider.

3. The pupil *applies his knowledge and understanding* in new and unfamiliar situations.

Specifications

(*i*) The pupil *analyses*...

- (*a*) the given example into what is given and what is to be found out ;
- (*b*) the given enunciation of a theorem into what is given and what is to be proved ;
- (*c*) the given problem or rider into a sequence of steps to be followed.

(*ii*) The pupil *formulates hypothesis*...

- (*a*) that "if congruent figures are always similar, then similar figures may always be congruent."
- (*b*) that "a circle is a convex set."

(*iii*) The pupil *collects*...

relevant data about a hypothesis ; *e.g.*,

- (*a*) What are the properties of congruent figures ? of similar figures ? Are they the same ?
- (*b*) What is a circle ? Does the segment determined by two points of a circle entirely lie on a given circle ?

(*iv*) The pupil *selects*...

relevant *data i.e.*, facts and principles for a particular situation ; *e.g.*, when the measures of two sides of a right-angled triangle are given, he selects the pythagorean principle to find out the measure of the third side.

(*v*) The pupil *judges*...

the adequacy of data or procedure or apparatus ; *e.g.*,

- (*a*) to draw a triangle, he needs at least three measures ;
- (*b*) to find out the volume of a cylinder one has to have its height ;
- (*c*) to locate a point on a plane, its x-coordinate and y-coordinate are required.

(*vi*) The pupil *verifies*...

a hypothesis, based on collected data :

- (*a*) the answer by substituting values in a given problem or equation ;
- (*b*) the answer by drawing a graph.

(*vii*) The pupil *suggests*...

- (*a*) an appropriate figure to solve a rider ;
- (*b*) a new illustration of a non-convex set ;
- (*c*) a new method of solving a problem or a rider ;
- (*d*) how to locate an irrational number on a number line.

(*viii*) The pupil *predicts*...

- (*a*) that a triangle having two obtuse angles is an impossibility ;
- (*b*) that in a triangle, if 1 (AB)=8, 1 (BC)=10, 1 (CA)=6, then, the triangle is a right-angled triangle.

(*ix*) The pupil *solves*...

new problems on factorisation, new riders, new constructions.

(*x*) The pupil *gives reasons*...for every step ; *e.g.*,

- (*a*) 5+3=3+5 (commutative property) ;

(*b*) $\triangle ABC \cong \triangle DEF$ (SAS)

(*c*) $a+0=25$

$\therefore$ $a=25$ (0, additive identity).

(*xi*) The pupil *interprets*...a given chart, table ; *e.g.*,

- (*a*) a chart showing the multiplication of two negative numbers on a number line ;
- (*b*) a logarithm table ;
- (*c*) a graph of simultaneous equations ;
- (*d*) a graph of $2x-3>10$.

(*xii*) The pupil *translates*...

- (*a*) verbal statements into mathematical terms, symbols and functions ; *e.g.*, five, when added to three, makes eight. $3+5=8$;
- (*b*) a given truth set into a graph ;
- (*c*) a given problem into an equation.

4. The pupil develops the *practical skills* required in the study of Mathematics.

Specifications

(*i*) The pupil *checks*...
mathematical instruments before he uses them ;

(*ii*) The pupil *rectifies*...
the defects in the instruments ; *e.g.*,

- (*a*) the leg of a pair of compass ;
- (*b*) the setting of the apparatus ; *e.g.* setting protractor for measuring angles, setting ruler for measuring segments.

(*iii*) The pupil *sets up*...
appropriate apparatus for drawing parallel lines, measuring lengths of segments, drawing a circle.

(*iv*) The pupil *measures*...
with reasonable accuracy the height, the redius, the circumference.

(*v*) The pupil *reads*...

- (*a*) graphs of equations ;
- (*b*) a pie-diagram showing the proportion of colours in the white ray ;
- (*c*) the abbreviations of trigonometrical ratios ; *e.g.*, tan θ is tangent θ ;

(*d*) the mathematical symbols such as $\cong$, $\subset$, ϕ, correctly ;

(*e*) the logarthmic and trigonometric tables correctly.

(*vi*) The pupil *records...*
the observations accurately and neatly.

(*vii*) The pupil *makes accurate observations...*
while reading graphs, tables.

(*viii*) The pupil *uses the data...*

which is relevant ; *e.g.*, To find the area of the floor of a room whose length is 4 m., breadth 3 m. and height 2.5m., the height is not to be used.

(*ix*) The pupil *sketches...*

(*a*) simple diagrams involving directions and distances ;

(*b*) diagrams of problems involving directions, distances and trigonometric functions.

(*x*) The pupil *draws...*

(*a*) a number line ;

(*b*) graphs : linear, parabola ;

(*c*) figures for theorems and riders.

(*xi*) The pupil *summarises observations...*

after an experimental approach ; he summarises : "The sum of measures of the three angles of a triangle is 180".

(B) Personality Objectives

5. The pupil develops an *interest* in Mathematics.

Specifications

The pupil, on his own,

(*i*) **reads...**

(*a*) funny stories, problems concerned with Mathematics ;

(*b*) books, magazines, newspapers, etc., giving mathematical information ; *e.g.*, *Mathematics Today* ;

(*c*) journals of research articles on Mathematics ;

(*d*) biographies of mathematicians ;

(*ii*) **visits...**

places of mathematical interest and importance ; *e.g.*, an observatory, laboratories, statistical departments ;

(*iii*) **participates...**

in activities like talks, debates, mathematical projects in or outside the school ; *e.g.*, "Modern Mathematics—A Necessity," "Mathematics and Life" ;

(*iv*) **collects...**

pictures, stamps, specimens, photographs, data, etc., of mathematical importance ; *e.g.*, specimens of leaves having symmetry, photographs of mathematicians, a picture of pyramid ;

(*v*) **prepares...**

models, charts, pictures, having a mathematical significance *e.g.*, a chart showing how to locate irrational numbers on a number line, models of polyhedrons, such as prisms, cubes, etc., graphs showing S.S.C. results of previous years ;

(*vi*) **contributes exhibits...**

concerning mathematical matters for a display organised in or outside the school ; *e.g.*, exhibits showing clock arithmetic, charts showing various base systems, various types of sets. venn diagrams ;

(*vii*) **writes...**

articles, news items, etc., pertaining to the subject matter of mathematics ; *e.g.*, writes on "Logical approach in Modern Mathematics," Why Modern Mathematics ?"

(*viii*) **prefers to attend to...**

programmes concerned with mathematics released on TV. radio ;

(*ix*) **takes up hobbies...**

of a mathematical nature ; *e.g.*, forming magic squares, gathering a quiz related to mathematics ;

(*x*) **meets...**

scholars of mathematics whenever possible ;

(*xi*) **helps...**

in the maintenance of a mathematics laboratory, museum.

6. The pupil develops a positive mathematical *attitude*.

Specifications

The pupil

(*i*) **respects...**

(*a*) research findings or new approaches contrary to the existing theory ; *e.g.* a circle and its circumference are not the same ; a 'point' is an undefined term ; set theory ; topology ;

(*b*) statistical information and interpretation ;

(*ii*) **accepts...**

only those suggestions which are based on conclusions derived from mathematical calculations and logical reasoning ;

(*iii*) **expresses...**

(*a*) his ideas by using mathematical examples clearly and precisely ;

(*b*) his ideas in a logical sequence ;

(*c*) his arguments giving reasons for each one of them ;

(*iv*) **arrives at judgements...**

after weighing all possible evidence carefully and dispassionately ;

(*v*) **considers...**

(*a*) new ideas, discoveries, inventions, free from prejudice ;

(*b*) quantitative aspects of a given problem ;

(*vi*) **reconsiders...**

his own judgements and beliefs in the light of new knowledge and theories ;

(*vii*) **co-operates...**

with others in arranging mathematical models, charts, apparatus, materials, etc., in their proper places while working in the mathematics laboratory ;

(*viii*) **faces...**

problems with full confidence.

7. The pupil *appreciates* the contribution of mathematics in all fields of knowledge and life.

Specifications

The pupil

(*i*) **expresses...**

(*a*) his realisation of the importance of mathematics in the progress of sciences and human culture ;

(*b*) his appreciation of man's effort to conquer nature and natural forces ;

(*c*) his appreciation of discoveries and inventions in any part of the world ;

(*d*) his pride in man's heritage, mathematics being a legacy of the past and a gift of the present.

(*ii*) **recognises...**

(*a*) the contribution of mathematicians to the fund of knowledge of mathematics ;

(*b*) the work of international agencies in this field ;

(*c*) the mathematical aspects evident in the nature ;

(*iii*) **derives a sense of pleasure...**

- (*a*) in understanding the achievement of mathematics ; *e.g.*, interplanatory travel, atomic energy and explosion, computers and their control of satellites, contribution of mathematics to the advancement of science and technology ;
- (*b*) when considering the underlying mathematical principles ; *e.g.* Nature's arrangement of symmetry in the shape of leaves, in the shape of the butterflies ;
- (*c*) in understanding the beauty of similarity, congruency, symmetry and balance in figures, decorations and in the natural set-up ;
- (*d*) in the company of students who are good at mathematics.

OBJECTIVES OF SCIENCE

(A) Classroom Instructional Objectives

1. The pupil acquires a *knowledge* of scientific terms, facts, concepts, phenomena, definitions, etc.

Specifications

(*i*) The pupil *recognises*...

- (*a*) the names of the parts of flowers, Newton's laws of motion, the smell of ammonia gas, parts of electric bell, etc.

(*ii*) The pupil *recalls*...

- (*a*) definitions of velocity, acceleration, mechanical advantage, chemical changes ;
- (*b*) the names of such phenomena as reflection, refraction, photo-synthesis, decolourisation ;
- (*c*) the names of parts of an apparatus or of an organism ;
- (*d*) the names of such laws as the Law of parallelogram of forces, Laws of pendulum, Boyle's Law.

2. The pupil develops an *understanding* of the terms, facts, definitions, concepts, principles, laws, relationships, functions, processes, phenomena, theories, etc.

Specifications

(*i*) The pupil *discriminates between*...

- (*a*) the solubility of copper sulphate and alum at the same temperature ;
- (*b*) the substances having the maximum fat content and other substances ;
- (*c*) lenses having more or less focal length.

(*ii*) The pupil *sees relationship*...
   (*a*) between camera and eye, between heart and pump.
   (*b*) between temperature and volume when pressure is constant ;
   (*c*) between the centigrade scale and Fahrenheit scale.

(*iii*) The pupil *selects*...
   (*a*) appartus to prove the laws of reflection ;
   (*b*) chemicals to prepare CO_2 ;
   (*c*) procedure to find out the density of a given substance.

(*iv*) The pupil *compares*...
   (*a*) long-sight and short-sight ;
   (*b*) mixture and compound ;
   (*c*) physical changes and chemical changes ;
   (*d*) dynamo and motor.

(*v*) The pupil *classifies*...
   (*a*) substances into elements, compounds and mixtures ;
   (*b*) substances into three types of levers ;
   (*c*) substances into roots and stems.

(*vi*) The pupil *cites illustrations*...
   (*a*) of an ideal flower ;
   (*b*) of substances having stable equilibrium ;
   (*c*) of phenomena based on the refraction of light ;
   (*d*) of allotrops of carbon, sulphur.

(*vii*) The pupil *detects errors*...
   (*a*) in a statement like "water is an element ;"
   (*b*) in the arrangement of an electrical connection in an electric bell ;
   (*c*) in a figure showing the preparation and collection of hydrogen gas ;
   (*d*) in formulae like $C=R/E$.

(*viii*) The pupil *rectifies errors*...
   in a given statement, arrangement of apparatus, picture, formula (rectifies the above illustrations).

(*ix*) The pupil *generalises*...
   (*a*) that $m\angle i = m\angle r$;
   (*b*) that a snake comes under reptile ;
   (*c*) that $C/100=F-32/180$.

(*x*) The pupil *verifies*...

(*a*) that $m\angle i = m\angle r$ by changing the position of pins ;

(*b*) the answer by substituting the values in a given problem.

3. The pupil *applies his knowledge and understanding* to new and unfamiliar situations.

Specifications

(*i*) The pupil *analyses*...

(*a*) an example into what is given and what is to be found out ;

(*b*) a problem into the various steps to be taken to solve it.

(*ii*) The pupil *formulates a hypothesis*...

(*a*) that "if sound waves also reflect like those of light, then in the case of sound also $m\angle i = m\angle r$" ;

(*b*) that "both light and sound are forms of energy ; so if light can travel through vacuum, sound can also travel through vacuum."

(*iii*) The pupil *collects*...

relevant data about a hypothesis :

(*a*) Do sound waves reflect ? Is their reflection regular or irregular ? Does it also depend upon the kind of reflecting surface ?

(*b*) Is the way of propagation of light waves and sound waves the same ? Are their speeds equal ?

(*iv*) The pupil *selects*...

relevant data ; *e.g.*, facts and principles, to a particular situation ; *e.g.*, for proving $m\angle i = m\angle r$ in the case of sound waves, he selects a reflecting surface, may be a mirror, but he will not select a convex mirror or lens.

(*v*) The pupil *judges*...

the adequacy of data or process or apparatus, whether :

(*a*) for studying the presence of CO_2 in the air, lime water is an adequate chemical ;

(*b*) for getting a spectrum on a wall, a prism is an adequate material.

(*vi*) The pupil *verifies*...

hypothesis based on collected data *e.g.*, given four unlabelled gas jars, if he comes to the conclusion that the last one contains CO_2, he verifies it by a lime-water test.

(*vii*) The pupil *gives new illustrations*...

(*a*) to prove that the process of purification of blood is a chemical change (if it is not discussed in the class) ;

(*b*) of simple and compound leaves.

(*viii*) The pupil *predicts*...

(*a*) that the volume of an air bubble rising from the bottom of a lake will increase ;

(*b*) the colour of green grass, while looking through a yellow glass.

(*ix*) The pupil *solves*...

new problems on finding density, focal length, solubility.

(*x*) The pupil *gives scientific reasons*...for statements like

(*a*) telegraph wires are kept loose ;

(*b*) water rises up in the capillary tube.

(*xi*) The pupil *suggests*...

theories, procedures, illustrations, processes, rectification, *e.g.*

(*a*) if he knows that Density=M/V then he suggests how to find out the density of a given solid ;

(*b*) he suggests the apparatus and procedure to find out the volume of a solid if there is no overflow vessel ;

(*c*) he suggests the procedure to identify O_2, CO_2 and NH_3 kept in separate unlabelled gas jars with the help of one test only.

(*xii*) The pupil *interprets*...the given chart, table, *e.g.*,

(*a*) chart, showing the nutritive value of various food items ;

(*b*) the periodic table ;

(*c*) a graph showing the relationship between temperature and pressure.

4. The pupil develops *skills* in practical aspects (like observation, performance, recording, setting) of science.

Specifications

(I) Skills Regarding Process of Performance

(*i*) The pupil *checks*...

- **(a) tools and apparatus like forks, spring balance,** burette, motor, spirit lamps ;
- (*b*) chemicals like hydrochloric acid, sodium hydroxide.

(*ii*) The pupil *rectifies*...

- (*a*) the defect in an apparatus ; *e.g.*, valves of the vaccum pump ;
- (*b*) the setting of the apparatus ; *e.g.*, in the absence of the plaster of paris, instead of ordinary corks, rubber corks are to be used.

(*iii*) The pupil *cleans*...

apparatus and tools before and after experiments.

(*iv*) The pupil *sets up*...

- (*a*) appropriate apparatus for an experiment ;
- (*b*) a prism, a convex lens, etc., in the right position.

(*v*) The pupil *measures*...

with reasonable accuracy ; *e.g.*, volumes, weights, lengths, temperature, areas, heights, etc., to the required decimals.

(*vi*) The pupil *makes accurate observations*...

- (*a*) of level of a liquid in a measuring cylinder ;
- (*b*) of mercury level in a thermometer ;
- (*c*) of R.B.C. and W.B.C. under a microscope ;
- (*d*) of the distance of objects and their images.

(*vii*) The pupil *records*...

- (*a*) the list of materials ;
- (*b*) the procedure ;
- (*c*) the observations accurately ;
- (*d*) the generalisations taken.

(*viii*) The pupil *performs* experiments with reasonable speed and accuracy and with neatness...

- (*a*) while studying the working of a kerosene pump (speed) ;
- (*b*) while measuring the length of a pendulum (accuracy) ;
- (*c*) while making connections of electric cells in parallel or in series (accuracy) ;
- (*d*) while finding the refractive index of glass (speed, accuracy, neatness).

(*ix*) The pupil *uses materials* not more than necessary...
  (*a*) for testing the properties of oxygen, $KClO_3$ and MnO_2 are taken not in excess but in proportion ;
  (*b*) in neutralisation, just enough NaOH (or HCL) is added to HCl (or NaOH).

(*x*) The pupil *replaces* the old apparatus or instruments methods by new ones...
  (*a*) for rubber tubes, plastic tubes may be used in certain experiments ;
  (*b*) instead of a long-necked retort for distillation, a flask with a long rubber tube may be used.

(II) Skills Regarding Product of Performance

(*i*) The pupil *sketches* diagrams...
  (*a*) of different parts of a flower or a stem, or a root ;
  (*b*) the setting of an experiment ;
  (*c*) the different parts of the human or animal body.

(*ii*) The pupil *draws* graphs...
  (*a*) of a load against tention ;
  (*b*) of temperatures against pressures (volume constant).

(*iii*) The pupil *summarises* observations...
  (*a*) acidic oxides turns blue litmus red ;
  (*b*) when the object comes nearer to the convex lens, the real image goes away.

(*iv*) The pupil *calculates* the results...
  (*a*) in the experiment on the Law of Moments, he calculates load × load arm and effort × effort arm ;
  (*b*) in the experiment of a U-tube, he calculates $h_1 \times d_1$ and $h_2 \times d_2$.

(*v*) The pupil *finalises* the results...
  (*a*) that load × load arm = effort × effort arm ;
  (*b*) that $h_1 d_1 = h_2 d_2$.

(*vi*) The pupil *records*...
  (*a*) aim, material and apparatus, procedure, observation and generalisation of the performed experiment ;
  (*b*) the preparation, collection, properties and uses of oxygen gas ;
  (*c*) the underlying principle, construction, working, uses, limitations of a dry cell.

(B) Personality Objectives

5. The pupil develops an *interest* in scientific and natural phenomena and work, and their applications in life ; *i.e.*, in the world of science.

Specifications

The pupil on his own

(*i*) **reads...**

- (*a*) novels, stories, etc., bearing on science ;
- (*b*) books, magazines, newpapers, etc., giving scientific information ; *e.g. Science Today* ;
- (*c*) journals of research articles on science ;
- (*d*) biographies of scientists ;

(*ii*) **visits...**

places of scientific interest and importance ; *e.g.*, an observatory, hospitals, laboratories ;

(*iii*) **participates...**

in such activities as talks, debates, science projects in or outside the school; *e.g.*, Air pollution ; Science—a blessing or a curse ? Science and civilisation ;

(*iv*) **collects...**

pictures, stamps, specimens, photographs, data, etc., of scientific significance ; *e.g.*, specimens of rocks, photographs of scientists, a picture of an eye ;

(*v*) **prepares...**

models, charts, pictures having scientific significance ; *e.g.*, charts showing three types of levers, a model of lungs ;

(*vi*) **contributes exhibits...**

concerning scientific matters for a display organised in or outside the school ; *e.g.*, exhibits showing a steam engine, electric signals ;

(*vii*) **writes...**

articles, news items, etc., pertaining to the subject matter of science ; *e.g.*, writes about the latest information available on "cancer," "ecology of the human organism ;"

(*viii*) **perfers to see...**

movies based on scientific scenes ;

(*ix*) **prefers to attend to...**

programmes of scientific interest released on TV ; radio ;

(*x*) **takes up hobbies...**

of a scientific nature ; *e.g.*, collection of rocks while going on hikes ;

(*xi*) **meets...**

scientists whenever possible ;

(*xii*) **helps...**

in the maintenance of a school museum, an aquarium, a botanical garden.

6. The pupil develops a scientific *attitude*.

Specifications

The pupil

(*i*) **shows...**

sympathy for the people affected by the accidents to planes, by explosions in a laboratory, by atomic explosions, by pollution of air, water, etc., by spread of diseases ;

(*ii*) **respects...**

research findings contrary to the existing theory ;

(*iii*) **accepts...**

only those suggestions which are based on the conclusions derived from scientific researches ;

(*iv*) **expresses...**

(*a*) his ideas, by using scientific examples clearly and precisely ;

(*b*) his belief in man as an agent who reveals the mystery of nature ;

(*v*) **arrives at judgements...**

after weighing all possible evidence carefully and dispassionately ;

(*vi*) **considers...**

new ideas, discoveries, inventions, free from prejudice ;

(*vii*) **reconsiders...**

his own judgements and beliefs in the light of new knowledge and theories ;

(*viii*) **co-operates...**

with others in arranging apparatus, materials, etc., in their proper places, when working in a laboratory ;

(*ix*) **follows...**

the instructions and guidelines issued by international organisations like WHO, UNESCO.

7. The pupil *appreciates* the contribution of science in all the fields of knowledge and life.

Specifications

The pupil

(*i*) **expresses...**
  (*a*) his realisation of the importance of science in human progress ;
  (*b*) his appreciation of man's effort to conquer nature and natural forces ;
  (*c*) his appreciation of discoveries and inventions in any part of the world ;
  (*d*) his pride in man's heritage, science being a legacy of the past and a gift of the present ;

(*ii*) **recognizes...**
  (*a*) the contribution made by scientists to our knowledge of science ;
  (*b*) the work of international agencies in this field ;

(*iii*) **derives** pleasure...
  (*a*) in understanding the advancement of science and technology ; *e.g.*, interplanetary travel, atomic energy and explosions, discoveries of new diseases and drugs, multi-storeyed buildings, sea-bridges, cloth fabrics, synthetic products ;
  (*b*) from a study of the underlying scientific principles ; *e.g.*, Natures arrangement for cross-pollination, mirage, usefulness of the plant kingdom to the animal kingdom, formation of rainbow ;
  (*c*) in understanding the beauty, gift, and mystery of the human body and its growth, of plants and their growth, of animals and their growth ;
  (*d*) in the company of students who are good at science.

OBJECTIVES OF WORK EXPERIENCE

This subject of work experience has been recently introduced, at the secondary school level. The school, naturally, is not expected to prepare and produce experts and technicians through this activity. The only purpose is to ensure that students develop manipulative skills and acquire a working knowledge and understanding of subjects such as woodwork, sewing, pot-culture, kitchen gardening, paper work, clay modelling, spinning, weaving, etc.

Let us consider the objectives and some of their specifications.

Objectives

1. The pupil acquires a *knowledge* of the elements of woodwork, sewing, pot-culture, kitchen gardening, paper work, clay modelling, spinning, etc.

Specifications

(*i*) The pupil *recognises...*
  (*a*) various technical terms like gluing, finishing, polishing, close circuit, open circuit, electric connection in parallel ;
  (*b*) various tools like a chisel, a saw, a spinning wheel, a spindle, a two-way switch.

(*ii*) The pupil *recalls...*
  (*a*) various terms like polishing, warp and woof ;
  (*b*) various concepts like blueprint, front view, output, input, productivity.

2. The pupil develops an *understanding* of the theory of woodwork, paper work, spinning, etc.

Specifications

(*i*) The pupil *explains...*
  The working of the spinning wheel, the need for electric connections in series.

(*ii*) The pupil *gives reason...*
  for lubricating the spindle, for the use of thin filament in electric bulb.

(*iii*) The pupil *detects defects...*
  (*a*) in the tools, in the working of handlooms.

(*iv*) The pupil *compares and contrasts...*
  (*a*) the scissors used for cutting the cloth, and that for cutting plants ;
  (*b*) various types of screws ;
  (*c*) different types of shuttles.

(*v*) The pupil *selects...*
  (*a*) appropriate instruments for doing a job ;
  (*b*) an appropriate method for doing that job.

3. The pupil *applies his knowledge and understanding* in new and unfamiliar situations.

Specifications

(*i*) The pupil *suggests...*
  an appropriate method for doing a job.

(*ii*) The pupil *calculates*...
  (*a*) the cost of finished products ;
  (*b*) the input and output ;
  (*c*) the coefficient of productivity.

(*iii*) The pupil *interprets*...
  (*a*) the graph showing the speed and output of work ;
  (*b*) the blueprint.

4. The pupil develops the *skills* required for work experience.

Specifications

(*i*) The pupil *handles*...
tools such as a saw, a chisel, a switch.

(*ii*) The pupil *checks*...
the tools before he uses them.

(*iii*) The pupil *rectifies*...
the defects in the tools.

(*iv*) The pupil *sharpens*...
the tools.

(*v*) The pupil *prepares*...
  (*a*) the models with accuracy ;
  (*b*) jointless articles, like handles, rulers, pointers ;
  (*c*) articles involving joints like a lamp-stand, a book shelf.

(*vi*) The pupil *draws*...
  (*a*) graphs, showing time against the output of work ;
  (*b*) diagrams showing front view, and side view of the articles ;
  (*c*) diagrams showing electrical connections.

(*vii*) The pupil *records*...
his observations accurately and neatly.

(*viii*) The pupil *applies*...
glue, lacquer, paint, etc., to the articles prepared.

(*ix*) The pupil *measures*...
with reasonable accuracy the height, the diameter, the circumference.

(*x*) The pupil *sets up*...
appropriate apparatus for drawing parallel lines, for measuring diameter.

4. The pupil develops *interest* in work experience.

Specifications

The pupil on his own,

(*i*) **reads...**
literature on work experience ;

(*ii*) **accepts...**
the activity as a hobby ;

(*iii*) **participates...**
- (*a*) in activities like pot-culture, kitchen gardening ;
- (*b*) in school exhibitions ;
- (*c*) in displaying his articles ;

(*iv*) **collects...**
materials that are useful for gaining efficiency in a job ;

(*v*) **visits...**
places like factories, exhibitions, cotton mills, etc., where knowledge can be enriched ;

(*vi*) **prepares to attend to...**
programmes concerned with work experience ;

(*vii*) **helps...**
in the maintenance of a work experience laboratory, museum.

5. The pupil develops an *attitude* for work experience.

Specifications

(*i*) The pupil *respects...*
- (*a*) the dignity of labour by participating in activities which involve labour ;
- (*b*) the labourer and the artisan ;

(*ii*) **considers...**
that labourers and artisans also have a worthy place in the society ;

(*iii*) **regards...**
self-help as an important virtue.

Evaluate Yourself

1. Bring out clearly the difference between specifications and learning outcomes.
2. State the objectives of teaching the mother tongue. Specify each objective in terms of at least three specifications.
3. (*i*) "The aim of work experience in schools is not to produce experts and technicians." Comment.
   (*ii*) Discuss the objectives of work experience in schools.

4. Comment on the following statements :
    - (*a*) A teacher expects his students of Std. V to understand the concept of atomic energy.
    - (*b*) A student of Std. VIII cannot read the clinical thermometer.
    - (*c*) A student of Std. X is unable to generalise from the given data about the measures of the angles of a triangle.
    - (*d*) A teacher says "The objective of history is to bring about an all-round development of a child."
    - (*e*) A teacher says : "My objective of teaching Gujarati is to complete the text book prescribed by the Government."
5. State the objectives of teaching the following subjects, and specify each objective in terms of at least three specifications :
    - (*a*) Mathematics (Std. VII).
    - (*b*) Science (Std. VIII).
    - (*c*) English as the mother tongue (Std. IX).
    - (*d*) English as a second language (Std. X).
    - (*e*) History (Std. X).
6. Specify each of the following objectives in terms of at least three specifications :
    - (*a*) The pupil develops an interest in Geography (Std. VIII).
    - (*b*) The pupil develops a positive attitude towards science (Std. IX).
    - (*c*) The pupil develops an appreciation of poetry (Std. X).

6

Content Analysis

What should come first ?

When the teachers talk about educational evaluation they generally discuss one very debatable problem : What should come first, content or objectives ?" Up till now, teachers laid great stress only on content while teaching or evaluating. In the modern concept of educational evaluation, however, objectives are in the forefront not only while learning activities are organised but also while testing is done. The modern concept of educational evaluation always assumes that educational objectives have previously been identified and defined. This is the reason why teachers are expected always to keep educational objectives in sight while planning the teaching-learning process and carry it out either in the classroom or outside it.

Still, the question—What should come first, content or objectives ?—remains unanswered. It is the job of the philosopher and educationist to decide upon the educational objectives first and then to frame the content, *i.e.*, curriculum, syllabus, course. Thus, teachers get the content readymade. So, naturally, when philosophers and educationists start with objectives, the teachers will have to start with the content because (*a*) the content is already prescribed and (*b*) because he is not expected to reorganise the content according to the objectives. On the contrary, the teacher is free to select those objectives from the taxonomies which may suit the content. Of course, while analysing content into teaching points, he will certainly keep objectives in mind ; so, in a way, it may also be said, that the teacher also starts with objectives.

Suppose a teacher wants to introduce the topic "Profit and Loss." He will analyse the content as follows :

(*a*) He will list all the new terms such as cost price, selling price, profit, loss, profit per cent, loss per cent ;

(*b*) He will write down the relationships of various terms in the form of formulae ; *e.g.*, C.P.$-$S.P.$=$Loss. S.P.$-$C.P.$=$Profit.

(*c*) He will make a list of understandings such as, when there is profit, the selling price is higher than the cost price ;

(*d*) He will collect the relevant examples on profit and loss.

In the teaching of a language, the content analysis will involve new words, new phrases, figures of speech, idioms, maxims, proverbs, incidental grammar, etc.

Now, while analysing the content, the teacher keeps in mind that (*a*) for testing a pupil's recall, new terms are the appropriate means, (*b*) for testing their understanding, various relationships and facts are the means, (*c*) for testing their application of knowledge and understanding, examples, familiar and unfamiliar, are the means. This means that while analysing the content into teaching points, the teacher keeps objectives in sight.

Without making it a point of dispute, we may say that curriculum-makers start with objectives and frame the curriculum accordingly so that the objectives can be achieved by the students ; but the teacher starts with the content and finds out the behavioural objectives which can be suitably achieved with the help of the content.

Below are given some illustrations wherein it has been shown how the teacher starts with the content, analyses the content into teaching points and finds out the appropriate specific objectives that can be suitably achieved by students. In the illustrations, in the first column, the content in the form of teaching points is given. In the second column, those specifications (behavioural objectives), which can be suitably achieved with the help of a given teaching point, are shown. The statements given in the second column may be considered as specifications or learning outcomes. At the end of each statement, the general objectives (non-behavioural objectives) have been shown parenthetically.

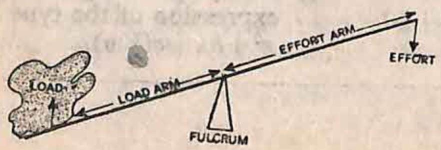
Illustration No. 1 **Unit : Factorisation**

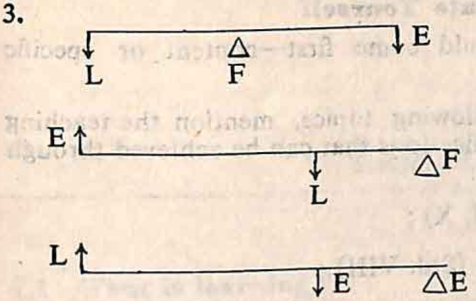
Content : Factorisation of the expression of the type x^2+bx+c

Teaching points	Specifications
1. a^3+a^2+a+4, x^2-y^2 m^2+5m+6, x^3-8, $p^2-12p+20$	1. The pupil recognises the expression of the type x^2+bx+c (Kn).

2. $(x+5)(x+6)=x^2+11x+30$ $(x-4)(x+5)=x^2+x-20$ $(x+3)(x-7)=x^2-4x-21$ $(x-8)(x-4)=x^2-12x+32$	2. The pupil recalls the product of $(x+b)(x+c)$ (Kn).
3. $(5)+(6)=11$ and $(5)(6)=30$ $(-4)+(5)=1$ and $(-4)(5)=-20$ $(3)+(-7)=-4$ and $(3)(-7)=-21$ $(-8)+(-4)=-12$ and $(-8)(-4)=32$	3. The pupil establishes the relationship between the constants (Und). 4. The pupil tabulates the data (Appl). 5. The pupil generalises the data (Appl). 6. The pupil explains how to divide the middle term of the given expression from the obtained data (Und).
4. Factorise $\left.\begin{aligned}&x^2-x-56\\&=x^2-8x+7x-56\\&=x(x-8)+7(x-8)\\&=(x-8)(x+7)\end{aligned}\right\}\begin{aligned}&\because(-8)+(7)\\&=-1 \text{ and}\\&(-8)(7)\\&=-56\end{aligned}$	7. The pupil states the method of factorisation of the expression of the type x^2+bx+c (Und). 8. The pupil verifies the generalisation (Appl).
5. Factorise (*i*) $(a+b)^2+12(a+b)+35$ (*ii*) $(x-y)^2-6(x-y)-55$	9. The pupil solves the unfamiliar examples of the same type (Appl. and Sk).

Illustration No. 2 **Unit : Mechanics** **Content : Levers**

Teaching points	**Specifications**
1. A machine is any device by which a force acting at a given point and in a given direction may be rendered available at some other point and in some other direction.	1. The pupil defines the term "machine" (Kn). 2. The pupil gives reasons why a lever may be called a simple machine (Und).
Lever is a bar free to turn about some point of the bar.	3. The pupil defines each type of levers (Kn).
2. 	4. The pupil labels different parts of a lever (Kn).

3. 	5. The pupil draws diagrams of the types of levers (Sk). 6. The pupil recognises the different types of levers (Kn).
4. Mechanical advantage is the ratio of load to effort. Mechanical advantage is the ratio of effort arm to load arm.	7. The pupil defines 'mechanical advantage' (Kn).
5. $\text{M.A.}=\frac{\text{load}}{\text{effort}}=\frac{\text{effort arm}}{\text{load arm}}$ *i.e.*, load × load arm = effort × effort arm.	8. The pupil translates the statement of mechanical advantage into formula form (Und). 9. The pupil recalls the formula of mechanical advantage (Kn).
6. Second type of levers always give M.A. because effort arm is always greater than load arm. The third type of levers always give mechanical disadvantage, for the effort arm is always smaller than the load arm.	10. The pupil gives scientific reasons (Und.) 11. The pupil gives reasons why the first type of levers may give mechanical advantage or disadvantage or no mechanical advantage (Und).
7. Balance, nut-opener, spanner, see-saw, nut-cracker, pliers, oar, wheel barrow, etc.	12. The pupil supplies new examples of each type of levers (Appl). 13. The pupil classifies the examples of levers into three types (Und).
8. Find the length of the load arm of a lever whose effort arm is 6 cm. and having M.A.=2.	14. The pupil solves examples involving M.A., load arm, and effort arm of a lever (Appl. and Sk).

Evaluate Yourself

(1) Explain : What should come first—content or specific objectives ?

(2) In each of the following topics, mention the teaching points and the specifications that can be achieved through each teaching point :

(*i*) Equilibrium (Std. X) ;

(*ii*) Plane separation (Std. VIII) ;

(*iii*) Non-co-operation movement (Std. VII) ;

(*iv*) Adjectives (Std. VI) ; and

(*v*) Winds (Std. IX).

7

Learning Experiences

7.1 What is learning ?

Psychologists agree only superficially on a definition of the term *learning*, although they all agree on the importance of *learning behaviour*. There has always been a general agreement among various authorities on the subject that learning refers to a more or less permanent *change in behaviour* which occurs as a result of practice.

The term behaviour, as is used here, demands special attention. It refers to mental, emotional and physical reactions or responses. So mental, emotional and physical *reactions* or *responses* are behaviours.

What, then, is meant by change in behaviour ? Consider an illustration. A child sees a flame. The flame is the stimulus. He puts his finger in the flame. This is his reaction or response. Let this be represented by the symbol $S \rightarrow R_1$. As the child gets his finger burnt, when he sees a flame (*i.e.*, the same stimulus) the next time, he does not put his finger in the flame. This is, again, his reaction or response to the same stimulus (*i.e.*, the flame). Let this be represented by the symbol $S \rightarrow R_2$.

Here, the reaction or the response to the same stimulus has changed. This is known as change in behaviour or behavioural change. The permanent change in behaviour is learning.

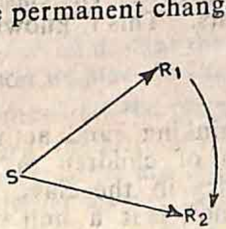


Fig. 7.1. What is learning ?

Thus, acquiring of knowledge, broadening of understanding, improvement in physical skills, developing of attitudes, deepening of appreciation, etc., are all classified as changes in behaviour.

Now suppose, in the above illustration, when the child sees the flame second time, he puts his finger into it. This means that the response has not changed. In other words, there is no change in behaviour, meaning thereby that learning has not taken place.

Learning is an inferred process, for one can never observe it directly. Suppose a teacher teaches a theorem. After the teaching is over, he says that he has taught the theorem. Can a student say that he has learnt it ? There is no evidence that he has. How, then, is the teacher to know that the student has learnt the theorem ? He has to put the student to a test. He may ask the student

—to state the enunciation of the theorem,

—to find out what is given and what is to be proved,

—to draw the figure that may help him to prove the theorem logically,

—to write down the proof of the theorem.

It is only from the students' performance that the teacher judges the change in performance that has taken place *before* and *after* he has introduced the theorem. This change in performance (*i.e.*, reaction or response) indicates the occurrence of learning.

7.2 Learning Activities

The term *learning activities* may be explaind as activities which include an arrangement of teaching aids, questioning, explanations, observations, visits, handling of apparatus, models, charts and specimen etc., reading, writing, drawing, etc., and which ultimately lead the students to learning.

Providing learning activities in the class or even outside of it is known as *teaching*. Listening to teachers, listening to students, speaking, thinking, observing, recalling, drawing figures, locating places on a map, etc., are learning activities. The classroom teacher provides these activities to his students. This is known as teacher's teaching.

7.3 Learning Experiences

Children learn by feeling, thinking and acting. Learning results from the active participation of children in the stimulus situation which the teacher provides in the class. Learning experience is *not* a part of a syllabus, nor is it a unit or a teaching point. It is *not* a traditional lesson plan nor simply activity. It is the *interaction* of the learner and the situation provided by the teacher. Each of these learning experiences modifies the behaviour of the pupil.

When a student takes part in learning activities, he develops certain understandings ; he realises, feels, appreciates something. For example, a student is asked to locate Delhi on the map of

India ; he does so. This is a learning activity. Now he understands or realises that

(*a*) Delhi is in the northern part of India ;
(*b*) it is on the bank of the river Yamuna ;
(*c*) its latitude is 23°N and its longitude 80°E ;
(*d*) it is a railway junction, etc.

In the above example, as a result of learning activity, the student gets some *after-effects* in the form of understanding or realisation or feeling or appreciation. These *after-effects* are called *learning experiences.*

Consider the following example. A teacher reads a poem and the students listen to it. This is a learning activity. At the end of it, a student

(*a*) gets tears in his eyes ;
(*b*) feels that the poem is superb ;
(*c*) realises that the poet has used a suitable metre to create a tragic atmosphere ;
(*d*) realises that the poem seems to be one of the best pieces of literature, etc.

Here the after-effects in the form of feeling or realisation are the learning experiences.

Take one more example. A teacher discusses the place value of different digits in the number 436. The students take part in the discussion. This is a learning activity. During the discussion a student

(*a*) understands that even if 3 is less than 6, the value of 3 in the number 436 is more than that of 6 ;
(*b*) understands that in the number 436, the value of 4 is more than that of 3 and 6 ;
(*c*) understands that the value of a digit in a number depends upon its place in the number ;
(*d*) appreciates the place value system in mathematics ; etc.

Here the after-effects in the form of understanding or appreciation are the learning experiences. These learning experiences constitute learning.

It will be seen from the above examples that learning experiences depend upon how well you can organise learning activities. The more adequate and methodical the learning activities are, the richer will be the learning experiences.

7.4 Learning Activities and Learning Experiences

We have already seen that learning experiences result from the interactions of learning activities. In order to produce different types of learning experiences, the teacher may provide various activities ; if he provides different learning activities, different types of learning experiences will result.

Again, in order to produce a particular type of learning experience, a variety of learning activities may have to be provided for. For example, to develop the understanding that the root of the river Ganga is in the Himalayas, the following activities may be provided for :

(*a*) The students may be asked to locate the Himalayas and the river Ganga on the map of India ;

(*b*) The students may be asked to observe and find out where the Ganga meets the Bay of Bengal ;

(*c*) The students may be asked to read, in their text book or in a reference book, the description of Gangotri from where the Ganga streams out ;

(*d*) The students may be asked to visit Gangotri.

In some cases, if a single learning activity is provided, different learning experiences may result. For illustrations, please see 7.3 above.

7.5 What is a Method of Teaching ?

Keeping in view the psychological needs of students, the sequence and order of certain learning activities are maintained in general so that students have a better participation and richer after-effects (that is, learning experiences). Such a planned and well-organised sequence of learning activities is termed *mothod of teaching*.

7.6 Teacher's Role

We have already seen that objectives are decided by philosophers and educationists. Keeping in view the objectives and the needs of the State and of Society at large, the content, in the form of a curriculum, is prepared. The curriculum is divided into standardwise syllabus, which is further divided into subjectwise courses. Again, keeping objectives and content in view, text books are prepared by subject experts. To a certain extent, teachers can play a role in preparing text books ; but these are few, and only those who are competent enough can do it. If an expert teacher-writer has knowledge of modern concepts of evaluation, he may even suggest—

(*a*) the specifications which are required to be developed through every topic in the text book ; and

(*b*) the organisation of learning activities in general which may help in the achievement of the specifications.

When the objectives and specifications have been set, and content text books are ready, the classroom teacher is expected to do the following :

1. After a thorough reading of the content, he should ascertain the units ;
2. Keeping the specifications in view, he should analyse the given unit into teaching points (content-analysis) ;
3. For every teaching point, he should decide on the specifications to be suitably achieved by students ;
4. Keeping specifications and the related teaching points in view, he should plan for the presentation of various learning activities to the students.

It is clear that, for a classroom teacher, the organisation of learning activities is the only functional aspect of the concept of evaluation available.

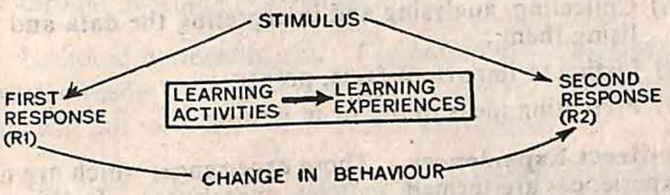


Fig. 7.2. Place of Learning Activities in Learning.

The teacher's job is to provide learning activities suitable to specifications on the one hand and teaching points on the other. The provision of these learning activities helps teacher-pupil interaction, pupil pupil interaction, and interactions within oneself. This interaction of learning activities results into learning experiences, which ultimately result in learning. This can be observed and judged from the change in behaviour which takes place in the response (R_2) from the previous one (R_1).

In short, the teacher will be entirely in charge of conducting the learning activities and will be responsible for making the whole class take part in them physically, mentally and socially. After all, teaching is an act of generating learning, and the skill on the part of the teacher lies in establishing a proper correspondence among teaching points, specifications and learning activities.

7.7 Classification of Learning Experiences

Learning experiences can be classified into two categories :

(*a*) Direct experiences ; (*b*) Indirect experiences.

Direct Experiences : Firsthand experiences with various objects or symbols are termed *direct experiences.* These experiences are more than perceptual learning in the sense that they include experiences with symbols. Perceptual learning arises out of experiences dependent upon seeing, hearing, smelling, tasting, touching, feeling, handling and manipulating objects in various ways. We get the meanings of terms like sweet-sour, soft-hard, green coloured, pulling, pushing, etc., through perceptual learning. We use symbolic words to describe them. Some of the illustrations of direct experiences are given below :

(*a*) Observing samples or specimens ;

(*b*) Experimenting with physical and chemical materials ;

(*c*) Setting up apparatus for experiment ;

(*d*) Constructing models, charts, plans, diagrams ;

(*e*) Drawing figures, painting models ;

(*f*) Dramatising historical events ;

(*g*) Summarising a lengthy description ;

(*h*) Collecting, analysing and interpreting the data and generalising them ;

(*i*) Listing to important facts, points ;

(*j*) Presenting ideas orally or in writing.

Indirect Experiences : Those experiences which are not first-hand experiences are termed *indirect experiences*. In this case, the direct experiences of others are made use of. It is very difficult to have direct experiences in all matters. Every student cannot get a direct experience in matters such as tremors of an earthquake, feelings while travelling by air or by sea. Tensing's thrilling experience when he set foot on the Everest, etc. A student can appreciate them through imagination only. Indirect learning experiences also have a place in the process of learning since it is impossible for all to have firsthand experiences. A person has recently visited Kashmir. He beautifully describes the beauty of Nature in Kashmir. The listeners enjoy it. On the part of the listeners, this experience is not firsthand experience ; it is an indirect experience. A student reads the description of the Jog Falls. He thrills. Even in the absence of the object or the stimulus (here, Jog Falls), a student will have a thrilling experience, which is an indirect experience. Here are some more examples of indirect experience :

(*a*) Reading accounts or descriptions or discussions in books, magazines, journals, newspapers ;

(*b*) Observing pictures, photos, maps, charts, models ;

(*c*) Listening to oral descriptions, lectures, talks.

It may be pointed out here that it is rather difficult to completely separate the activities resulting in direct and indirect experiences ; it may not even be desirable to do so. In many activities there may be combinations of direct and indirect experiences.

7.8 Characteristics of a Good Learning Experience

The responsibility of the classroom teacher is to provide to his students learning situations composed of a variety of learning activities, so that they may have direct as well as indirect learning experiences which ultimately result in learning.

The problem which now arises is : What should be the criteria for choosing a good learning experience ? What are the characteristics of a good learning experience ?

1. The learning experiences should be directly related to the behavioural objective, since our aim is to achieve the behavioural objective through learning experiences.

2. It should be meaningful. For example, asking students to take down the theorem written on the blackboard without understanding it will not result in a meaningful experience.

3. It should satisfy the psychological needs of the learner. For example, for adolescents detective stories may be made available and for school children the fairy tales.

4. It should be appropriate to the maturity level of the learner. For example, primary school children should be asked to write essays on topics like—The cow, The postman, My school, The fair, etc., while the secondary school students should be asked to write essays on topics like—If I were a Head master ; Patriotism ; An evening at the seashore ; An ideal student.

5. It should be related to life situations, so that it may be more effective, more meaningful, and the learner will be more satisfied. For example, it will be better to ask children to add 25 pencils to 32 pencils rather than to ask them to add 32 and 25.

6. It should be reinforced. For example, the experience of the function of a motor may be reinforced by the experience of the function of dynamo. Both types of reinforcements, positive and negative, may be made use of in enriching the experience.

7. It should be intensive. How to produce an intensive experience is an art. Again, how to change (increase or decrease) the intensity of an experience is also an art. The use of audio-visual aids in this connection would be very helpful.

8. It should be varied, rich in content and novel. Multi-sensory experiences will be helpful in sustaining interest in an activity. A novel experience also will ensure that students are not bored. A student who studies the digestive systems of various animals will get a richer experience than the one who studies the digestive system of only one animal. The novelty, richness and variety of an experience sustain the interest and motivation of the students.

9. It should be related to the availability of material and of time. This is the practical aspect of selecting learning experiences.

7.9 Sources of Learning Experiences

A person lives amongst thousands of stimuli around him. Every movement, except when he is sleeping, he has to attend one or the other stimuli. If he is not responding to any physical stimulus he may be doing so to a stimulus in the form of ideas, new or old, original or borrowed from others. In other words, in his conscious state, a person is always reacting to stimuli. He has a lot of chances to change his reactions (*i.e.*, behaviour) in a desirable direction, that is, to learn. He has every chance of having learning experiences. There are many sources of learning experiences, which we shall group under some common heads.

1. **Home** : The home provides a number of learning experiences, *e.g.*, sitting, standing, walking, running, talking, oral expression, etc. The home is mostly an informal agency.

2. **Society** : Many desirable and undesirable experiences are provided by society. Many vices or virtues can be developed through all these experiences. You can develop honesty or dishonesty. This is again an informal agency.

3. **Peer groups** : Learning experiences through the peer groups help in developing such qualities as honesty, we-feeling, leadership, etc.

4. **School** : A school is society in miniature. This is a formal agency providing a variety of learning experiences.

(*a*) **Experiments** : They provide learning experiences related to laboratory skills.

(*b*) **Excursions and visits** : They provide learning experiences which may help students to develop certain good qualities like co-operation, helpfulness, etc. Again they help to develop the skill to budget for the expenditure, how to face problems, etc. The students come in contact with people of various types speaking different languages.

(*c*) **Exhibitions** : They provide learning experiences which may help students to develop the we-feeling, skill of presentation, etc.

(*d*) **Audio-Visual Aids** : They widen the scope of knowledge and understanding. Again, they provide learning experiences which develop pupils' interest.

(*e*) **Co-curricular activities** : Debating, elocution, dramatisation, help students to achieve skill in expression systematising arguments, reasoning, etc.

(*f*) **Sports and Games** : They provide learning experiences which may help students to develop qualities of leadership, an attitude of co-operation, an ability to follow others, the we-feeling, sportmanship, etc.

(*g*) **Methods of teaching** : Group discussion method, assignment method, workshops, seminars, etc., provide various types of learning experiences to widen the horizon of the students' knowledge and understanding.

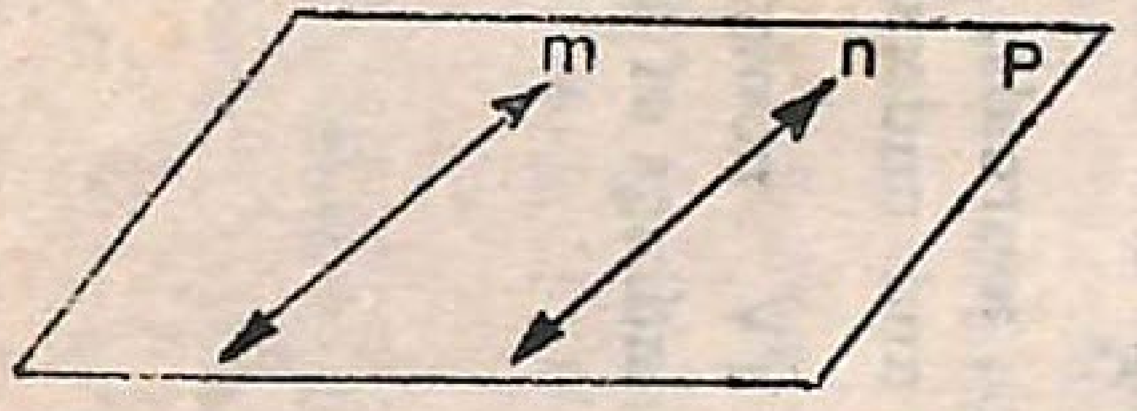
(*h*) **School library** : Books, journals, magazines, etc., enrich the student's knowledge and understanding.

5. **Mass-media** : Radio, TV, newspapers, libraries, etc., enrich the knowledge and understandings of students.

Table : Specimens illustrating 1-1 correspondence among Teaching Points, Specifications and Learning Activities

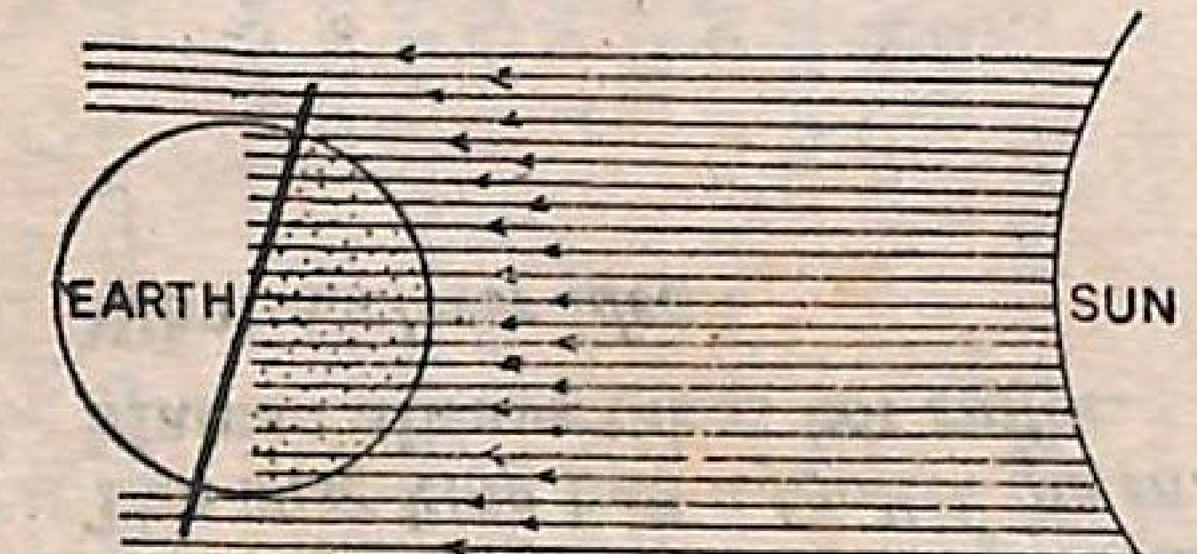
Specimen 1

Content : Parallel Lines **Std. VIII**

Teaching points	**Specifications**	**Learning activities**
 Two lines are parallel if and only if they are coplanar and do not intersect.	1. The pupil draws two intersecting lines on the plane (Und-Sk).	1. Vijay, come here and draw two intersecting lines on the board (a plane).
	2. The pupil draws two non-intersecting lines on the plane (Und-Sk).	2. Bharat, draw two non-intersecting lines on the board (a plane).
	3. The pupil defines coplanar lines (Kn).	3. Nila, define "coplanar lines".
	4. The pupil defines parallel lines (Kn).	4. The teacher explains and defines the parallel lines.
If m, n $\subset P$ and $m \cap n = \phi$ then $m \parallel n$	5. The pupil reads the symbolic expression (Und).	5. Neelam, read the statement I have written on the board.
	6. The pupil explains the statement (Und).	6. Manish, explain the statement.
	7. The pupil takes down the statement correctly (Sk).	7. Please take down the symbolic statement carefully in your notebook.

Specimen 2

Content : Phenomenon of day and night **Std. VII**

Teaching points	**Specifications**	**Learning activities**
1. The earth is round. 2. The earth rotates on its own axis.	1. The pupil recalls the shape of the earth (Kn). 2. The pupil recalls the motions of the earth (Kn).	1. Ajay, what is the shape of the earth ? 2. Pankaj, which are the two motions of the earth ?
3. 	The pupil answers after observ- i the model (Und). 4. A above. 5. The pupil accurately draws the given diagram (Sk).	The teacher presents the model. He asks the students to observe the working of the model and reply to the following questions. 3. Which part of the earth gets the rays of the sun ? 4. Which part of the earth does not get the rays of the sun ? 5. The teacher asks students to draw the diagram accurately.
4. At the equator, the rays are perpendicular. Therefore, it gets more heat. 5. At the poles, the rays slant. They get less heat.	6. The pupil explains the cause and effect relationship (Und). 7. The pupil gives a scientific reason (Appl).	6. Geeta, why does the equator get more heat ? 7. Kishan, give a scientific reason for "The climate in the land of the Eskimos is severely cold."

Specimen 3

Content : Adjectives **Std. VI**

Teaching points	**Specifications**	**Learning activities**
1. Kishan has a *green pencil.* 2. The *old man* is a *toothless person.* 3. The *wise king* had a *foolish queen.* 4. Manish always takes *hot coffee.*		The teacher presents the five sentences pre-written on the roll-up board. The teacher asks the students to
5. What a *clever idea* !	1. The pupil reads the given sentences (Kn).	1. read these sentences,
	2. The pupil copies the sentences carefully (Kn).	2. take down these sentences carefully,
	3. The pupil underlines the nouns (Kn).	3. underline the nouns,
	4. The pupil finds out the words that tell us something about the nouns (Und).	4. find out the words that tell you something about the nouns, and underline them.
"The word that tells something about the noun is called an adjective."	5. The pupil generalises (Appl). 6. The pupil defines the term "Adjective" (Appl).	5. The teacher helps the students to generalise. 6. The teacher helps the students to define an adjective.
1. The dark clouds disappeared. 2. I have five pens. 3. That bird sings well. 4. He does not drink much water.	6. The pupil underlines the adjectives (Appl.).	7. Underline adjectives in the given sentences.

7.10. Establishing 1—1 Correspondence

We have seen what we mean by learning activities and learning experiences. In the previous chapter, we learnt how correspondence is to be established between content (teaching points) and specifications. Let us go one step ahead. Now, we would like to see how correspondence among teaching points, specifications and learning activities is to be established. The teacher is supposed to be very alert and skilful in organising and presenting learning activities, keeping in view the specifications and teaching points. To organise and present learning activities in a classroom situation is an art and a science too. On the previous pages are given some of the specimens (those are only specimens) which clearly show this type of horizontal relationship among teaching points, specifications and learning activities. Please consider it carefully because this relationship is to be kept in mind when a teaching-learning process is in progress.

7.11. Emotionalised Learning Experiences

We have already seen that objectives can be conveniently classified into three domains : (a) objectives from the cognitive domain ; (b) objectives from the affective domain ; and (c) objectives from the psychomotor domain. As far as our present-day curriculum and the attitude of the classroom teachers towards the teaching-learning process are concerned, it is evident that teachers stress the achievement of objectives from the cognitive domain and neglect those from the affective and psychomotor domains. We have already discussed some of the reasons which account for the neglect of the affective objectives in article 3.13.

It is an accepted fact that in shaping one's behaviour, the learning experiences of all the three domains play an important role. They are, so to say, indespensable for the all-round development of personality.

John Ruskin once remarked : "You do not educate a man by telling him what he knows not, but by making him what he was not." Here, the emphasis is on behaviour (conduct) rather than knowledge. A man of right conduct and of less knowledge is preferable to a man of knowledge indulging in a wrong conduct. An illiterate man of high character, right conduct and polished manners is an asset to society while a literate man of low character, undesirable conduct and rough manners is a liability. One of the aims of our education is to create good and intelligent citizens, literate citizens having high character, right conduct and polished manners. How is this aim to be achieved ?

The answer is that teachers should emphasise the learning experiences of the affective domain. These learning experiences are termed *emotionalised learning experiences*. They will shape the personality of the students, will direct their behaviour in a way that is desirable for society. The teacher should make a greater effort to provide the emotionalised learning experiences.

In this age, we need to promote fellow-feeling, honesty, responsibility, co-operation, independence, leadership, followership, etc. This will include the provision of emotionalised learning experiences, as a result of which students develop right positive attitudes, appreciations, interests and habits of good behaviour. The teacher is responsible for all these learning experiences in the classroom and without it.

Today the situation is not quite satisfactory. Sometimes our first class graduates or post-graduates, irrespective of their mastery of their subject, cannot get along with others. Why does this happen ? This happens only because the important aspect of the formation of attitudes which control an individual's behaviour has been totally neglected in their so-called education.

Literacy is not education. When good behaviour, which includes many qualities such as self-control, civic sense, sympathy towards the poor, disgust for injustice, respect for others, etc. is added to literacy, it becomes education. Literacy is a part of education and not the whole of education. It results from the achievement of cognitive objectives, while education is the result of the achievement of the objectives of all the three domains.

No wonder emotionalised learning experiences play an important role (*i*) in shaping the all-round development of an individual's personality, and (*ii*) in making an individual educated in the true sense of the word.

Educators should try their best to evaluate the attainment of objectives not only from the cognitive domain, but also from the psychomotor and affective domains. Then, and only then, will educational evaluation become complete.

Evaluate Yourself

1. Explain : What is learning ?

2. To what does the term "behaviour" in the concept of evaluation refer ?

3. What is a change in behaviour ? Illustrate.

4. Why is learning called an inferred process ? Explain with the help of an example.

5. Explain the terms "learning activities" and "learning experiences," giving suitable examples.

6. What is meant by the "method of teaching ?"

7. Describe the teacher's role in teaching.

8. For each of the following learning activities, suggest what learning experiences can be had by students :
    - (*i*) Bharat is asked to point out the stomach in the chart showing the organs of the digestive system.
    - (*ii*) Ashok is asked to prepare and collect CO_2 in the laboratory.
    - (*iii*) Kishan is asked to read a poem loudly.
    - (*iv*) Manish is asked to solve a rider based on congruent triangles.
    - (*v*) Neelam is asked to show the rivers of Southern India the map.
    - (*vi*) Shakuntala is asked to locate Bombay on the map of India.
    - (*vii*) Pankaj is asked to draw a circle of 5 cm. radius.
9. Discuss the two types of learning experiences, direct and indirect, giving suitable examples.
10. What are the characteristics of a good learning experience ?
11. Describe the various sources of learning experiences. Mention which type of learning experiences each of them provides.
12. Write a short note on :

    Emotionalised Learning Experiences.
13. Explain the concept of learning experience and mention their sources. What criteria would you use in their selection ? Illustrate.

A unit should satisfy the following criteria :

1. It should signify the unity or wholeness of learning activities related to some problem or project ;
2. It should emphasise the psychological principle of "learning by whole" ;
3. It should give importance to integrated learning outcomes ;
4. It should not represent only the subject matter but learning experiences as well.
5. It should emphasise the organisation of the subject matter into units of experience ;
6. It should organise a similar type of content ; and
7. It should be organised in such a way that it achieves a certain set of specifications and objectives.

Here are some of the examples of units :

Language : 1. letter writing ; 2. stories ; 3. essays ; 4. dramas ; 5. autobiographies ; 6. idioms ; 7. prepositions ; 8. clause analysis ; 9. figures of speech ; 10. prosody.

Science : 1. light ; 2. magnetism ; 3. electricity ; 4. beat ; 5. sound ; 6. water ; 7. how machines work ; 8. energy ; 9. radioactivity.

Mathematics : 1. set theory ; 2. number systems ; 3. open sentences ; 4. equality and inequality ; 5. symmetry ; 6. similarity ; 7. congruency ; 8. mensuration ; 9. binary operations ; 10. graphs.

History : 1. ancient culture ; 2. the Moghuls ; 3. the Marathas ; 4. what we owe to the British ; 5. contribution of the British to Indian literature ; 6. independence movement ; 7. freedom-fighters ; 8. India before 1947 ; 9. India after 1947.

Geography : 1. the Equatorial region ; 2. seasons ; 3. world clocks ; 4. winds ; 5. neighbours of India ; 6. visit to Antarctic ; 7. voyage from Bombay to London.

(B) Objectives to be Realised

The objectives to be realised through the unit are the second dimension of the year plan. In every unit of a subject, knowledge objectives are always there. But in some of the units one may find more opportunities for the development of understanding than in other units. Through some units more skill may be developed than through other ones. Through some units more application of

8

The Year Plan

8.1. The Planning

The present era is a planning era. In every activity, be it in finance, education, defence, population, industry, etc., planning is a *must*. Without planning, a nation or an individual cannot move a step ahead. This shows that for any activity, group or individual, planning is a pre-requisite. Planning is the backbone of school administration. It is a very broad term, but we shall restrict its meaning to the teaching-learning process only.

Good teaching does not just happen. It requires adequate and extensive planning so that the objectives, the specifications, the teaching strategy to be employed, the textual material and the evaluation procedure are all related in some meaningful fashion. Most teachers recognise the importance of having some systematic procedure for ascertaining the extent to which their objectives and specifications have been realised by their pupils.

8.2. The Year Plan

When a teacher is entrusted with the teaching of a subject in the beginning of the year, his very first task is to plan for the year's work. This plan is known as the *year plan*. While planning, the teacher would have to consider the following factors :

(*a*) The units to be taught in the subject ;

(*b*) The objectives to be realised through the various units ;

(*c*) The number of periods available during the year ;

(*d*) The number of periods to be assigned for testing.

(A) Formation of Units

The teacher is expected to recognise the content of the text book on the subject into suitable units. This recognisation is necessary only when the matter is not systematically presented in the text book.

> A unit may be defined as a large subdivision of the subject matter wherein a principle or a topic or a property is central to the well-organised matter.

knowledge and understanding is possible than through other units. Again, through almost all units, interest, attitude and appreciation can more or less be developed. This is so in the case of language units as well. Some units give more or less scope for comprehension or expression, than others do.

If the teacher is competent enough, he can, while preparing the year plan, realise the extent to which the various objectives can be achieved through the different units of a subject matter. This can be done by giving more or less weightage in terms of grades (*e.g.*, A, B, C, D, E) that the teacher wants to give to various objectives. It has been suggested that, in the year plan, periodwise distribution of objectives for each unit should be mentioned. For example ;

THE YEAR PLAN

Subject : History **Std. IX** **Total periods available : 48**

Units	knowledge	understanding	application	skill	Total teaching periods
1. European's colonising competition	2	3	2	1	8
...	...	...	...	...	

It is quite clear that this type of planning is totally impracticable, for many of the objectives develop simultaneously when the teaching-learning process is adequately organised. Such allotment of periods for developing various objectives serves no purpose at all and seems ridiculous.

The grading system, in this case, seems meaningful, as it indicates the weightage to be given to particular objective while dealing with the unit. Of course, time distribution is the only useful purpose served by the Year Plan.

(C) Time Available (*for teaching*)

While planning, a teacher should necessarily consider the time factor. The number of periods allotted per week will enable a teacher to calculate how many periods would be available during the year for teaching a subject. He will have to be very careful here. He has to consider the non-availability of the periods during examination weeks, sports and games week, exhibition week, non-teaching days, preparatory days for examination or school social gathering day, etc. When the available number of periods are properly assigned to the units of a subject, in accordance with its requirements the arrangement is known as *year planning*.

Here the teacher has to bear one thing in his mind. He cannot increase or decrease the total number of periods available for a subject, since the number of periods per week for a subject is fixed by the Education Department ; and the course (content) for a subject is also laid down. The teacher will have to use his discretion and his past experience before assigning a particular number of periods to the different units of a subject.

(D) Time Required (*for Testing*)

While calculating the total number of periods available for teaching a subject, the teacher will have to take into account the number of periods required for unit testing. When a unit is taught, a test known as *unit test* is to be held. For this testing, periods are required.

In the year plan, the number of periods required for testing per unit should also be mentioned.

All these four aspects are to be mentioned in the year plan over and above such .general information as the subject, the standard, etc. Specimen plans are given on the following pages :

Specimen 1

THE YEAR PLAN

Subject : Geography **Std. VIII** **Total periods available : 60**

Units	Objectives					Periods required		
	Knowledge	Under-standing	Application	Skill	Interest, aptitude, appreciation	teaching	for testing	Total
1. Astronomy (*a*) The stars and the solar system (*b*) The Earth as a planet	B	A	A	B	A	8	2	10
2. Motions of the Earth (*a*) Rotation & Revolution ( ) Latitudes & Longitudes (*c*) Day and Night (*d*) Seasons	B	A	A	A	A	9	2	11
3. The Atmosphere (*a*) Composition & layets (*b*) Temperature & pressure (*c*) Rainfall	B	A	B	C	A	8	2	10
4. Major Natural Regions of the World (*a*) Equatorial (*b*) Tropical (*c*) Monsoon (*d*) Mediterranean (*e*) Temperate (*f*) Coniferous (*g*) Tundra	B	A	A	B	A	21	5	26
5. Practical Geography : map-reading and making.	B	B	B	A	A	2	1	3
					Total	48	12	60

Specimen 2

Subject : Algebra Std. VIII Total periods available : 120

Units	Objectives					Periods required		
	Knowledge	Under-standing	Application	Skills	Interest, attitude, appreciation	for teaching	for testing	Total
1. Set	A	A	A	A	A	16	4	20
2. Number systems	B	A	A	B	A	14	4	18
3. Laws of exponents	B	A	A	B	A	4	2	6
4. Open sentences	B	A	A	B	A	4	2	6
5. Expansion	B	A	A	B	A	9	3	12
. Factorisation	B	A	A	B	A	9	3	12
7. Simplification	B	A	A	B	A	6	2	8
8. Linear equation	B	A	A	A	A	7	3	10
9. Prime numbers, H.C.F. & L.C.M.	B	A	A	B	A	6	2	8
10. Formulae	B	A	A	B	A	9	3	12
11. Statistics	B	A	A	B	A	6	2	8
					Total	90	30	120

Specimen 3

Subject : Chemistry Std. IX Total periods available : 90

Units	Objectives					Periods required		For experiments
	Knowledge	Under-standing	Application	Skill	Interest, attitude, appreciation	for teaching	for testing	
1. Sulphur	B	A	B	A	A	6	2	1
2. Nitrogen	B	A	B	A	A	6	4	1
3. Atomics tructure	B	A	A	A	A	10	7	1
4. Atomic weight & equations	B	A	B	B	A	12	6	1
5. Copper, silver & gold	B	A	B	C	A	12	4	1
6. Organic compounds	B	A	A	B	A	12	4	1
					Total	58	26	6/90

Specimen 4

Subject : English Prose Std. X Total periods available : 48
(Kumar Bharati, Higher Level)

Units	Lesson Nos.	Objectives				Periods required		Total
		Knowledge	Comprehension	Expression	Interest, attitude, appreciation	for teaching	for testi	
1. Essays	4, 5, 6, 7, 11, 13, 15, 16	A	A	A	A	20	3	23
2. Stories	1, 2 8, 12	A	A	A	A	9	2	11
3. Great men's life sketch	3, 17	A	B	C	A	4	1	5
4. Plays	10, 14	B	A	A	A	4	1	5
5. Humerous pieces	9, 10	B	A	B	A	3	1	4
					Total	40	8	

Evaluate Yourself

1. What is a Year Plan ?
2. Define a "unit." What are the criteria of a unit ?
   What factors are considered while preparing the year plan ?
3. Describe the utility of a year plan.
4. Why is a year plan necessary ? Mention any three advantages.
5. Prepare a year plan for each of the followimg subjects :
   - (*a*) Mother tongue (Std. VIII)
   - (*b*) History (Std. IX)
   - (*c*) Geography (Std. VII)
   - (*d*) Mathematics (Std. X)
   - (*e*) Science (Std. V)

9

The Unit Plan

9.1. The Unit

When the matter in the text book is not adequately grouped and prescribed, the teacher has to reorganise and regroup the given matter of a subject into suitable units.

> A unit may be defined as a large subdivision of the subject matter wherein a principle or a topic or a property is at the centre of the well-organised matter.

Refer to articles 8.1 and 8.2 (A) for details.

9.2 The Unit Plan

The planning for a unit is known as the *Unit Plan*. When should the teacher prepare the Unit Plan—before the year plan has been prepared or after it ? The answer is not simple. Unless he has a thorough knowledge of each of the units of a subject, he cannot prepare the year plan. So, in a way, the unit plan should be prepared first. But, again, while preparing the unit plan, the availability of the periods cannot be lost sight of. This is possible only if the year plan is ready. The year plan should therefore be ready before one starts preparing the unit plan. A teacher, who is experienced and competent enough in the subject matter, should prepare the year plan, keeping in mind the *ins and outs* of the units of the subject.

While planning a unit, the following factors should be borne in mind :

1. Objectives with specifications (the *why* aspect of the unit) ;
2. Content analysis the *what* aspect of the unit) ;
3. Learning activities (the *how* aspect of the unit) ;
4. Testing procedures (*Evidence* of achievement).

9.3. Successive Steps in Unit Planning

A unit should be viewed as a whole. You should be thoroughly familiar with the content before you make any attempt to write out the successive steps.

1. Content Analysis

In unit planning emphasis is placed on analysing its content into terms, concepts, facts, situations, processes, generalisations, conclusions, principles, laws, relationships, etc. In the language units, it should be analysed into new words, new phrases, idioms, facts, figures of speech, central idea, concepts, proverbs, word-building, etc.

This analysis helps the teacher to have a thorough knowledge of the subject matter. It would help him to teach with a full awareness of the depth of the subject matter. The teacher, again, enters the class with full confidence since he has mastery over the subject matter. Again, because of the content analysis the teacher will not be likely to miss any point while teaching the subject.

2. Objectives with Specifications

The second step is to find out the objectives with specifications that can be realised through the content analysis.

3. Learning Activities

The third step is to organise those activities that will best achieve the specifications. To organise learning activities in the most befitting and beneficial manner is an art as well as a science. Keeping individual differences and the psychology of the pupils in view, the content, specifications, and the learning activities should be planned in the unit plan.

4. Testing Procedures

This is the fourth and the last step in the unit plan. Here, the types of evaluation tools and techniques are mentioned through which the teacher would get evidence of the achievements of objectives on the part of the pupils.

9.4. Unit Plan vs. Daily Lesson Plan

A daily lesson plan is a plan showing the teaching points, specifications, to be achieved, organisation of learning activities in detail and the actual test items to which students are to be exposed.

1. A unit may extend over more than a period, it may take 8—10 periods, depending upon the subject matter, the specifications to be achieved and the learning activities to be organised, while a daily lesson plan is confined only to one period.

2. In a unit plan, the content is grouped under the headings of terms, concepts, facts, generalisations, principles, etc., while in a daily lesson plan the content is presented in the form of teaching points and is serialised in a psychological and logical sequence.

3. In a unit plan, the learning activities are merely mentioned, while in a daily lesson plan they are shown in detail.

THE UNIT PLAN

Subject : English Unit : Gulliver in the Land of Brobdingnag (Parts I and II)
Std. VII No. periods : 4.

Content Analysis	Objectives with Specifications	Teaching-learning Process	Evaluation Procedures
Central Idea Gulliver's adventures in Brobdingnag, the land of giants, and comparison with his adventures in the land of Lilliput.	*Comprehension* The pupil gives the central idea in his own words.	The teacher reads the lesson loudly. The pupil listens. The teacher explains the substance and the pupil gives the central idea.	Written test. Essay type questions.
Description The fields of barley, trees, the huge stile, the inhabitants, prodigious strides, gigantic houses, the huge furniture, cups, etc Gulliver's curiosity, surprise, fear ; master's behaviour, his kindness, his youngest son's mischief and other adventures.	*Expression* The pupil describes the land of giants.	The teacher narrates and asks the questions on : (*a*) the kind of inhabitants. (*b*) the reaction of the inhabitants. The pupil listens and answers.	Short answer type questions. Give reasons. Match the columns. Daily assignments.
New words and phrases To cast anchor, inhabitants, to entertain one's curiosity, to lament, ignorant, to convince, gratitude, substantial.	*Knowledge* The pupil gives the meanings of words and phrases from the lesson.	The teacher explains the new words and phrases with illustrations.	Make sentences. Match the columns.
	Comprehension The pupil uses new words and phrases in his own sentences.	The pupil uses them in his own sentences.	Oral test—reading with correct pronunciation, speed, pause, intonation and punctuation.
	Expression 1. The pupil tells the whole story in his own words. 2. He expresses how he would feel in Gulliver's place. 3. He writes the story, using new words and phrases.	The teacher asks a student to tell the story and imagine himself in Gulliver's place. The pupil tells and writes the story. He describes how he would feel in Gulliver's place.	Essay type questions short-answer type questions.

The unit plan should give a clear idea to the supervisor of what the teacher and pupils are going to do at a particular time during the learning process.

4. In a unit plan, the types of evaluation tools and techniques are mentioned, while in a daily lesson plan the actual test items to be exposed to the pupils are a pre-requisite. The test items may be in the form of an essay or an objective or a short-answer type of questions.

5. Daily lesson plans should be made in the context of the over-all unit plan and should be continuous from one day to the next. The work of each day should be, in a way, an extension and continuation of the previous day's work. Daily lesson plans should not be fragmentary or inefficient.

Evaluate Yourself

1. What is a unit ?
2. What points should be kept in mind while planning a unit ?
3. Explain the successive steps in unit planning.
4. Distinguish between a unit plan and a daily lesson plan.
5. State whether the following statements are true or false.
    - (*a*) The teacher should not reorganise the matter given in the text book.
    - (*b*) The unit should be viewed as a whole.
    - (*c*) Daily lesson plans need not be continuous from one day to the next.
    - (*d*) If a text book contains ten chapters, it *must* have ten units.
6. What points should be kept in mind while planning the learning activities ?
7. Select a unit from your special methods and prepare a unit plan.
8. How are unit plans related to year plan ?

10

The Unit Test

10.1. Introduction

The year plan is followed by the unit plan which ultimately is followed by the unit test. In the unit plan, the last stage is the *testing procedures* ; in other words, it is the *unit test*. It is a small test to be given at the end of teaching a unit.

A unit test can be made an effective instrument of evaluating (*a*) the achievement of objectives, (*b*), the content, *i.e.*, the academic achievement and (*c*) the learning activities, We do not, and should not, evaluate only the content ; we should evaluate the total behaviour of the pupil. This is possible only when we evaluate the achievement of the objectives of all the three domains *viz.*, cognitive, psychomotor and affective.

10.2. When to Evaluate ?

Evaluation is a continuous process. It has been said that teaching and testing go together. Even while teaching *i.e.*, organising learning activities, the teacher can evaluate. The pupil's responses or reactions, in the form of replying to a question, performance, facial expressions, etc., make evaluation a continuous process. This is the ideal situation, which may not be attained by a majority of teachers.

On the other hand, to postpone evaluation till the entire course has been completed (*i.e.*, annual examination) or till the half course has been completed (*i.e.*, terminal examination) is also unscientific and unpsychological.

Some of the stages, which may be properly marked for testing procedures, are :

1. During teaching (one extremity) ;
2. At the end of teaching a daily lesson ;
3. *At the end of teaching a unit* ;
4. At the end of the term ;

5. At the end of the year or curriculum (the other extremity).

The golden mean is to hold a test at the end of a teaching unit, which is known as the *unit test*.

A Word of Caution

Remember, that the time factor for testing depends upon the nature of the objectives to be tested. For example,

1. Point-to-point information (knowledge objective) can be suitably tested either in the course of teaching or at the end of teaching a daily lesson.

2. The objective of understanding or comprehension requires a comparatively longer period for its testing.

3. Objectives of application and skill require a sufficiently longer period for their testing.

4. The long-ranged objectives, such as interest, attitude and appreciation, take a lot of time for their development. These objectives can be well tested at the end of the year or when the curriculum has been completed.

In short, the teacher should exercise his direction in testing the objectives, keeping in mind the nature of the objectives in relation to the time factor. He should change the weightage of the objectives to be tested at different times.

10.3 Why Unit Test ?

We have seen that learning is more important than teaching. Now the problem arises : What is more important – learning or testing ? Both are equally important in the sense that testing gives us an idea of how far the learning has taken place. Secondly testing improves learning if the results of testing are suitably made use of for feedback or remedial teaching. Thus testing, if properly done, leads to good learning. Testing should be pre-planned, systematic and scientific.

For an adequate unit test, an adequate unit plan is necessary. If the unit plan is properly drawn, it facilitates the setting of a unit test properly, because a well-planned unit plan will give us a full idea of how much weightage is to be given to the content, the objectives, the form of questions, etc., while planning the unit test.

10.4 The Unit Test

The unit test is a short test to be given at the end of teaching a unit, and is not a random assortment of questions. Nor is it a test of 15 or 25 marks instead of 100 marks, as it is understood by many teachers at present. The so-called unit tests arranged by secondary schools are not unit tests at all. By setting question paper of 15 or 20 marks instead of 100 marks we do not have a unit test.

If at all we want to make a unit test an effective instrument of evaluation, it has to be structured according to a systematic pattern decided in advance. Some of the necessary steps for setting up a good and meaningful unit test are :

(A) **Planning (Design) of the Test :**

- (*i*) Selection of objectives and sub-units (content) ;
- (*ii*) Weightage to objectives ;
- (*iii*) Weightage to different areas of content ;
- (*iv*) Weightage to differernt forms of questions ;

Blue print

- (*v*) Weightage to difficulty level ;
- (*vi*) Scheme of options ;
- (*vii*) Sections in the question paper.

(B) **Editing the Unit Test :**

- (*i*) Selection of test items ;
- (*ii*) Grouping of test items ;
- (*iii*) Instructions of examinees ;
- (*iv*) Sections in the question paper ;
- (*v*) Preparing a marking scheme and scoring key.

(C) **Reviewing the Question Paper :**

- (*i*) Questionwise analysis (before the test is given) ;
- (*ii*) Critical evaluation of the test (before the test is given) ;
- (*iii*) Item analysis (after the test is given).

Let us consider these steps in detail.

10.5 (A). Design of the Unit Test

To begin with, the design of the test is prepared so that it may be used as an effective instrument of evaluation. A proper design would increase the validity, reliability, objectivity and suitability of the test. The design of a unit test lays downt he following dimensions :

(1) Selection of Objectives and Sub-units (Content)

The unit plan will give the teacher an idea of the objectives and the sub-units to be tested. Now, the objectives included in the unit plan may require different types of testing procedures such as a written test, an oral test, a performance test, observational techniques, etc. A different system is required to evaluate the objectives from the affective domain and the psychomotor domain. Here, we shall consider only the objectives from the cognitive domain.

(2) Weightage to Objectives

Here, the relative importance of each objective is to be considered. Generally, for informative subjects like History, Geography, Mathematics and Science, the objectives are knowledge, understanding, application and skill. For languages, the objectives are knowledge, comprehension, understanding (grammar), expression and appreciation. The main task here is to decide the weightage to be given to the different objectives included in the unit plan. This weightage should be decided by a committee of experts, including the classroom teacher, and should not be left completely to chance or to the individual discretion of teachers. A specimen is given in Table 10.1.

(3) Weightage to Sub-units (Content)

Here, the weightage is to be decided for the different areas of the content which are included in the unit plan. There are different methods to weigh the sub-units.

(*i*) Weightage to each sub-unit according to the number of pages allotted to it in the text book.

(*ii*) Weightage to each sub-unit according to the number of periods devoted to it.

(*iii*) Weightage to each sub-unit according to the number of specifications that can be achieved through it.

(*iv*) Weightage to each sub-unit according to the opinion of the committee of experts in the subject.

A specimen is given in Table 10.2.

(4) Weightage to Different Forms of Questions (Item Format)

For testing different abilities and sub-units, different forms of questions may be suitably used, instead of using the traditional form—the essay type question. In testing various learning outcomes, the essay type, the short-answer type and the objective type questions may be judiciously used.

For example, if the learning outcome to be measured is stated as "the pupil organises his ideas in a logical and coherent fashion," the multiple choice item format would be inappropriate. If the learning outcome is stated as "the pupil recalls names, places, dates and events," it would not be efficient to use a lengthy essay type question.

Although there are instances where the learning outcome can be measured by different item formats, the teacher should select the least complicated one. It is the specifications in the unit plan which would give us an idea of what form of questions would be the best to test a learning outcome and content. A specimen of this is given in Table 10.3.

(5) Weightage to Difficulty Level

It is an accepted fact that, in a classroom, there are three types of pupils—above average, average, and below average. Accordingly, the test should not be too difficult or too easy. A test should provide a suitable opportunity to the bright, the mediocre and the weak students in the class. Hence, all the test items in a test should not be very difficult or very easy. Now, who is competent enough to decide about the difficulty level of a test item? It is the teacher who would decide this. He gains competence through experience. No statistical method is to be employed here to decide about the *difficulty value* of the test item. The teacher is expected to classify his test items into three levels—difficult, average and easy. This is quite enough for the teacher-made tests.

A specimen of this is given in Table 10.4.

The Blueprint

The blueprint is a three-dimensional chart, showing the weightage given to objectives, content and forms of questions (item format) in terms of marks.

Why a blueprint ?

Have we ever seen

(*i*) an engineer build a structure without using a blueprint ?

(*ii*) a tailor make a suit without a pattern ?

(*iii*) a plumber or electrician work in a new home without referring to some type of blueprint ?

We have not. But we have seen some tests constructed by teachers and college professors who did not use some type of plan or guide or blueprint, and their tests reflected it.

The blueprint serves many useful purposes :

1. It may help improve the content validity of teacher-made tests ;

2. It defines, as clearly as possible, the scope and emphasis of the test ;
3. It relates objectives to the content ;
4. It provides greater assurance that the test will measure learning outcomes and course content in a balanced manner.

Who Should Prepare the Blueprint ?

There is nothing wrong about involving students in the development of a blueprint ; in fact, wherever feasible students' involvement should be encouraged, if for no other reason to make them feel that they have played some role in planning the course. Of course, the major and final responsibility will be that of the teacher, who is the decision-maker, not the students. Students' input should be considered by the teacher while he is making his decisions and it should be utilised only in an advisory capacity.

When to Prepare the Blueprint ?

Should the blueprint be prepared before the test is constructed or should it be prepared well in advance ? To be of the utmost benefit, it should be prepared well in advance. It would thus assist the teacher in organising his teaching material, serve as a monitoring agent, and help keep the teacher from *straying off* his instructional track.

The specimens of the weightage-tables and corresponding blueprint are given below :

Design of the unit test

Subject : Algebra Std. VIII
Unit : Set Theory Total marks : 50

Table 10.1 Weightage to Objectives :

Objectives	Percentage	Marks
(1) Knowledge	10	5
(2) Understanding	30	15
(3) Application	40	20
(4) Skill	20	10
Total	100	50

Table 10.2 Weightage to sub-units (Content) :

Sub-units	Percentage	Marks
(1) Concept of set	10	5
(2) Set Notation	10	5
(3) Types of sets	10	5
(4) Set Relation	12	6
(5) Subsets	8	4
(6) Set Operations	30	15
(7) Venn Diagrams and Examples	20	10
	Total 100	50

Table 10.3 Weightage to Item Formats :

Forms of Questions	Percentage	Marks
(1) Essay	20	10
(2) Short answer	30	15
(3) Objective type	50	25
	Total 100	50

Table 10.4 Weightage to the Difficulty Level :

Difficulty level	Percentage	Marks
(1) Easy	30	15
(2) Average	50	25
(3) Difficult	20	10
	Total 100	50

One can tally the three weightage tables—10.1, 10.2 and 10.3—with the blueprint (Table 10.5). The weightage to the difficulty level (table 10.4) is not to be mentioned in the blueprint, but it should be kept in mind while setting the question paper.

(6) Scheme of Options

There are two types of options : External options and internal options.

BLUEPRINT

Table 10.5 The Blueprint : A Three-Dimensional Chart :

Objectives	Knowlegde			Understanding			Application			Skill			Total
Content	E	S	O	E	S	O	E	S	O	E	S	O	
1. Concept of set	1	—	—	—	—	2	—	—	2	—	—	—	5
2. Set Notation	1	—	—	—	1	—	—	2	1	—	—	—	5
3. Types of sets	1	—	—	1	1	—	—	2	—	—	—	—	5
4. Set Relation	1	—	—	—	—	1	1	1	1	—	—	1	6
5. Subsets	1	—	—	1	1	—	—	1	—	—	—	—	4
6. Set Operations	—	—	—	2	—	4	—	2	4	—	—	3	15
7. Venn Diagrams and Examples	—	—	—	—	—	1	—	2	1	—	2	4	10
Total	5	—	—	4	3	8	1	10	9	—	2	8	50
	5			15			20			10			

E =Essay type S=Short-answer type O=Objective type

In the case of external options, there are various methods. Some of the samples are given below :

Method 1 The students are asked to attempt any *five* questions out of the given *eight*. This is an example of *overall* options.

Method 2. The students are asked to attempt any *three* from the first section, any *two* from the second section and any *two* from the third section. This is an example of *sectionwise* options.

Method 3 : The students are asked to attempt *all* the questions but every question has an alternate option, *e.g.*

Q. 4. Draw a triangle in which 1 (BC)=5 cm.
Altitude AM ⊥ side BC=3.5 cm. and m<B=55^0

OR

Q. 4. Construct a square of the area 21 sq. cm.

This is an example of *questionwise* options.

In the case of internal options, the option is given within a question. For example, write an essay on *one* of the following; fill up any *eight* blanks of the following; write short notes on any *two* of the following; etc.

Should Options be Given ?

The answer is "No." The reasons are given below :

(*i*) The purpose of a unit test is to have *complete* evaluation of the achievement of objectives, the content and the learning experiences. This purpose is not served if options are given.

(*ii*) It is extremely difficult to set two alternative questions or two alternative groups of questions, which measure the achievement of the same objectives, the same content or the same learning experiences.

(*iii*) It has been observed that it is rather difficult and confusing to select any of the optional questions even for the above average students. Why then talk of average or below average students ?

(*iv*) As far as school tests are concerned, they are all competitive test, where the performance of each student is compared with that of another. In such situations, it is not justifiable to give either internal or external options.

(*v*) The scheme of options may develop some wrong practices among students. They may omit some content. They may develop a dislike of some topics of the content. In the old scheme of Elementary Mathematics, it was observed that some students omitted Arithmetic and Geometry completely and attempted only Algebra to get through this subject. This happens when options are given.

(*vi*) The scheme of options in a test paper influences even the teacher's teaching. The insincere teacher may skip over some of the points of the content matter, which he thinks are difficult to explain to, or difficult of understanding by, students. It is no surprise if one finds a teacher advising his pupils to omit some parts of the content on the basis of the scheme of options.

(*vii*) The passing standard is already low, for it is only 35 per cent of the full marks. By adopting the scheme of options, we further lower the standard.

(7) Sections in the Question Paper

The inclusion of objective type items, short-answer type items and essay type items necessitates the division of the question paper into two sections, one comprising of objective type items and the other comprising of short-answer type items and essay type items. A separate time limit for answering each section should be considered while planning for a unit test, for it is not advisable to keep the section containing objective type items with the students for longer than the time required for answering them. The second section may be administered after a little break.

10.5 (B). Editing the Unit Test

Once the design is thoroughly prepared, the next step is to edit the test in the form of a question paper. In editing the test, the follwing steps should be borne in mind :

(1) Selection of Test Items

The opinion of scholars on this aspect of educational evaluation is divided on the point : When to coin the test items ? This may lead to one more question : When to prepare the blueprint ?

It is an accepted fact that "teaching and testing go together." It follows from this dictum that the teacher, while teaching, should simultaneously set the paper, meaning thereby that he should continually coin the rest items. It is from the responses of the students either in the class or in the tests that good multiple choice items can be coined. The process of coining different types of test items should go along with the teaching-learning process.

The same item, sometimes, can be presented in various forms and kept ready for use at the time of a test. If one form is used in one test, the other forms may be conveniently used in other tests. Every school should have subjectwise *item-banks.* More and more items should be added to the item-banks every day, every month, every year.

Experience indicates that even if a blueprint is prepared well in advance, that is, before the teaching-learning process starts, it will not be of much use as far as the organisation of learning activities is concerned. Of course, a well-prepared unit plan is very useful for organising learning activities, more useful than a blueprint. It follows from this discussion that a blueprint may be prepared at the end of the teaching of a unit. By that time, a rich item-bank should be ready.

It an item-bank is ready and if a blueprint is ready, the only job that remains to be done by the teacher is to select test items from the item-bank in accordance with the design of the blueprint. The most difficult job is to coin test items. To coin better test items calls for a lot of effort on the part of the teacher. It calls for a mastery of the content and practice in wording test item. But once they are ready, editing a question paper will become easier.

Table : One of the suggested forms of preserving test items in an item-bank.

Test Item No. 32 Subject : Mathematics Unit : Set Theory
Sub-unit : Subsets

Specification : The pupil calculates the number of subsets of a given set, when a formula is not provided.

Objective : Application.

Instruction : Put the mark √ against the correct reply in the space provided.

Test item : How many subsets will there be of set A which contains 3 members ?

(*i*) 3
(*ii*) 8
(*iii*) 9
(*iv*) None of the above.

Marking scheme or scoring key : (ii)

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(2) Grouping of the Test Items

While grouping test items, the following points should be borne in mind :

(*i*) All the objective type items should be grouped in one section. while the short-answer type and essay type items should be grouped in another section.

(*ii*) In the section of objective type items having the same format, *e.g.*, yes-no type, true-false type, matching type, multiple-choice type, etc., should be grouped together.

(*iii*) Items in each section should be arranged in order of their difficulty, as far as possible.

(3) Instructions to Examinees

The following points should be taken into consideration :

(*i*) General instructions may be given at the beginning of a question paper ; *e.g.*,

(*a*) This paper has two sections, A and B ;

(*b*) All questions in sections A and B are compulsory, etc.

(*ii*) Specific instructions related to each section may be given at the beginning of each section ; *e.g.*,

(*a*) Answers to section A should be given on the question paper itself ;

(*b*) Maximum time for this section is 15 minutes ; etc.

(4) Sections in a Question Paper

Generally, objective type items ard grouped under section A and short-answer and essay type questions are grouped under section B.

(5) Preparing Marking Scheme and Scoring Key

A marking scheme is essential in the case of short-answer and essay type items. It indicates :

(*a*) The number of points or steps expected in the answer ;

(*b*) The outline of each point or step expected in the answer ;

(*c*) The weightage to each of these points or steps.

Advantages

(*a*) A marking scheme helps the examiner to bring about a uniformity of standard in assessing and thereby increases the objectivity of the test.

(*b*) Many examiners may be judiciously involved in assessing answer books.

A scoring key is essential in the case of objective test items. In the srcoing key, the itemwise correct response in terms of its number is to be mentioned. For example :

Item No.	32	(*d*)
	33	(*c*)
	34	(*d*)
	35	(*a*)
	56	(*i*)—(*b*), (*ii*)—(*e*), (*iii*)—(*a*), ... etc.
	60	(*i*) T, (*ii*) T, (*iii*) F, (*iv*) T, (*v*) F, etc.

10.5 (C). Reviewing the Question Paper

It is advisable to review the question paper before it goes to press. This will enable the paper setter to remove any flaws in the question paper ; *e.g.*, ambiguity in the wording of a question, spelling mistakes, unnecessary clues, etc.

A review of the question paper necessitates three steps :

1. questionwise analysis (before the commencement of the test) ;
2. critical evaluation of the test (before the commencement of the test) ; and.
3. item analysis (after the test is over).

1. Questionwise Analysis

The purposes of a questionwise analysis are :

(*a*) To know the strength and weaknesses of a question paper more thoroughly ;

(*b*) To tally the question paper with the blueprint ;

(*c*) To determine the content validity of a test ;

(*d*) To give satisfaction to the paper-setter that the paper exactly agrees with the design.

Each question is analysed into :

(*a*) Objective ;

(*b*) Specification ;

(*c*) Content (topics) ;

(*d*) Type/Form of question ;

(*e*) Estimated difficulty level ;

(*f*) Approximate time required ;

(*g*) Marks allotted.

These details are generally collected in a tabular form.

2. Critical Evaluation of the Test

Before a test paper is sent to press, it should be subjected to a critical revision by subject experts who may be able to discover its shortcomings. The following points should be considered while checking :

(*i*) The directions to students should be as clear, unambiguous, complete and concise as possible. Nothing should be left for guess work.

(*ii*) There should be an adequate coverage of all the topics, specifications and learning activities.

(*iii*) There should not be any items that test only trivial points.

(*iv*) All the criteria that are necessary, while preparing the objective type test items, should be fulfilled. Please refer to article 14.1.

(*v*) Similar types of items should be placed together to speed up scoring and evaluation and enable students to take full advantage of the mind set imposed by a particular item format.

(*vi*) The test items should be graded, that is, arranged in order of their estimated difficulty level.

(*vii*) Classroom tests should be power tests and not speed tests. The time allotted should be such that at least 95 per cent of the students in the class should be able to complete the test within the stipulated period of time.

(*viii*) A marking scheme and scoring key should be kept ready.

3. Item Analysis

Item analysis begins after the test is over. The replies of the examinees are to be analysed to check the effectiveness of the test items. Only those items which are effective are to be retained, while those which are not should either be discarded or improved. This is known as the *process of item analysis*.

An item analysis helps in determining :

(*a*) the difficulty value of each item ;

(*b*) the discriminating power of each item ;

(*c*) the effectiveness of distractors in the given item.

This is a highly statistical procedure which is usually followed in the process of standardisation of a test, and this is more than what classroom teacher is expected to know.

Evaluate Yourself

1. What is a unit test ? Why should we plan unit test ?
2. Explain how the time factor for testing depends upon the nature of objectives.
3. Mention the necessary steps for setting up a good and meaningful unit test.
4. Discuss the various dimensions to be considered while planning the design of a test.
5. Discuss the various points to be considered while editing a test paper and while reviewing it.
6. Review a question paper of your choice at the last annual examination held in your school.
7. Review a question paper of your choice at the S.S.C. Examination (Std. X) of March' 78.

8. What is a blueprint ? Why should we have a blueprint ? Who should prepare The blueprint ? When ?

9. Discuss the three dimensions of a blueprint.

10. What are the different schemes of options ? Illustrate. Should options be given ? Justify your views.

11. What points will you consider while preparing a form for writing a test item ?

12. Write short notes on :
    - (*a*) Marking scheme and scoring key ;
    - (*b*) The blueprint and its importance ;
    - (*c*) Design of a unit test.

13. Select one unit of your choice. Prepare a blueprint for preparing a unit test.

14. How do the following aspects enable a teacher in the preparation of a unit test ?
    - (*a*) Questionwise Analysis ;
    - (*b*) Weightage to content matter and forms of questions ;
    - (*c*) Blueprint.

15. How do options in an examination paper influence ?
    - (*a*) the teaching of a teacher ?
    - (*b*) the study habits of students ?

16. Write short notes on :
    - (*a*) Questionwise Analysis ;
    - (*b*) Weightage to Objectives.

17. What is the importance of a marking scheme and a scoring key in a test ?

18. Mention any four general features of a unit test.

19. What purpose is served by a questionwise analysis of the test ?

20. Explain the importance of item analysis.

21. Write down the frame of a blueprint with the headings for the appropriate columns of it.

22. What is the significance of blue print in a unit test ?

11

A Good Measuring Instrument

Essential qualities

Like a good tool or a machine, a good measuring instrument must meet certain minimum requirements before it is deemed to be reliable. What are the essential characteristics and requirements of a good measuring instrument ? These are planning, validity, reliability, objectivity, discriminating power, adequacy, practicality, comparability and utility. All of these qualities are criteria that must be given serious thought when a teacher selects a measuring instrument.

I Planning

The very first requirement of a good measuring instrument in the field of education and psychology is adequate planning. In the preceding Chapter we have seen that an adequate planning calls for design of an instrument, which includes different weightages to be given to the different aspects of the tool. Again, it may require editing as well as review. The success of the measuring instrument lies in its proper blueprint. The reader is requested to refer to the preceding Chapter to get the idea how planning should be done.

II Reliability

The reliability of a test may be defined as—

1. "the degree of consistency among test scores";
2. "the degree of consistency with which the test measures what it does measure."

If a watch regularly goes 2 minutes ahead of the Indian Standard Time, it may be said that it is not valid, for it does not measure, what it is supposed to measure ; but it is reliable in the sense that it consistently goes 5 minutes ahead.

A test score is called reliable when we have reasons for believing it to be stable and trustworthy. Any measuring device provides only very limited data. What we hope for is the fact that a student's score should be similar under slightly different conditions. If we measure a student's level of achievement, we hope that his score would be similar under different administrators, using different scorers, with similar but not identical items, or during a different time of the day.

In physical measurement, ordinarily very reliable measures can be obtained. This is true primarily for three basic reasons :

(*a*) Physical characteristics can be usually measured directly rather than indirectly ;

(*b*) The instrument used to obtain the measure is quite precise ;

(*c*) The traits or characteristics that are measured are relatively stable.

Psychological and educational measurements are typically much less reliable than physical measurements. A psychological or educational measurement is indirect and is connected with less precise instruments or traits that are not always stable or well-defined. There are many reasons why a pupil's test score may vary. Some of them are :

(*a*) **Trait instability** : The characteristics we measure may change over a period of time ;

(*b*) **Sampling error** : Any particular questions we ask in order to infer a person's knowledge may affect his score ;

(*c*) **Administrative error** : Any change in direction, timing or amount of rapport with the test administrator may cause score variability ;

(*d*) **Scoring error** : Inaccuracies in scoring a test paper will affect the scores.

(*e*) **Other factors** : Such things as health, motivation, degree of fatigue of the pupil and good or bad luck in guessing may cause score variability.

Methods of Estimating Reliability

Reliability is usually expressed by a coefficient of correlation which is called the *reliability coefficient*. The methods used to estimate reliability differ in that they allow different sources of error to show up. Many approaches can be used to estimate reliability ; but the more common ones are :

(*a*) Test Retest Method ;

(*b*) The Alternate or Parellel Forms Method ;

(*c*) The Split Half Method ;

(*d*) The Rational Equivalence Method.

All these methods are highly statistical ; they are ; therefore, not very useful to the ordinary classroom teacher.

Factors Influencing Reliability

The factors that affect the reliability estimates are :

(*i*) **Method** : The method used in obtaining data on reliability affects the reliability coefficient. The method that takes into account both stability and equivalence will tend to give a lower coefficient than the other methods.

(*ii*) **Interval** : With any method involving two testing occasions, the longer the interval of time between two test administrations, the lower the coefficient will tend to be.

(*iii*) **Test Length** : Adding equivalent items makes a test more reliable, while deleting them makes it less reliable. For example, a test of 40 items is more reliable than a test of 10 items, and less reliable than a test of 100 items.

(*iv*) **Speed** : A test is considered to be a pure speed test if everyone who reaches an item gets it right, but no one has time to finish all the items. Here, score differences depend upon the number of items attempted. The opposite of a speed test is a power test. A pure power test is one in which everyone has time to try all items but, because of the difficulty level, ordinarily no one obtains a perfect score. Few tests are either pure speed or pure power tests. However, to the extent that a test is speeded, it is inappropriate to estimate reliability through the Split-Half Method. In that case the Test-Retest Method or Parallel Forms Method should be used.

(*v*) **Group Homegeneity** : Other things being equal the more heterogeneous the group, the higher the reliability. In other words, the test is more reliable when applied to a group of students with a wide range of ability than one with a narrow range of ability.

(*vi*) **Difficulty of the Items** : Tests in which there is little variability among the scores give lower reliability estimates than tests in which the variability is high. Too easy or too difficult tests for a group will tend to be less reliable because the differences among the students in such tests are narrow.

(*vii*) **Objectivity of Scoring** : The more subjectively a measure is scored, the lower its reliability. Ordinarily objective type tests are more reliable than subjective or essay type test. However, objectivity should not be confused with reliability. A test having a high scoring objectivity, such as a true-false test, may be quite unreliable as a measuring instrument.

(*viii*) **Ambiguous Wording of Items** : When questions are interpreted in different ways at different times by the same students, the test becomes less reliable.

(*ix*) **Inconsistency in Test Administration** : Inconsistency in test administration such as deviations in timing, procedure, instruction, etc., flucuations in interest and attention of the pupils. shifts in emotional attitude, etc., make a test less reliable.

(*x*) **Optional Questions** : If optional questions are given, the same students may not attempt the same items on a second administration ; thereby the reliability of the test is reduced.

III Validity

The validity of a test may be defined as—

(*i*) "the accuracy with which a test measures whatever it is supposed to measure" ;

(*ii*) "the efficiency with which a test measures what it attempts to measure"

(*iii*) "the accuracy with which a test reliably measures what is relevant".

> "An evaluation procedure is valid to the extent that it provides an assessment of the degree to which pupils have achieved specific objectives, content matter and learning experiences."

Validity is the most important consideration on the selection and use of any testing procedure.

It should always be remembered that—

(*a*) Validity is an inclusive term, and includes and is affected by all the other characteristics of the measuring instrument.

(*b*) Validity is a matter of degree. It may be high, moderate or low. It does not exist on an *all-or-none* basis. For example, the result of a Geometry test may have a high validity for indicating logical deductive reasoning, a moderate validity for indicating skill in drawing figures and low validity for indicating computational skill.

(*c*) Validity is specific rather than general. A test may be valid for one specific purpose but not for another, valid for one specific group of students but not for another. For example, an ordinary foot-rule may be—

(*i*) valid for measuring the length of a segment in milimetres but not valid for measuring the same in fractions of a milimetre ;

(*ii*) valid for measuring the length of a room, but not for measuring the distance between Bombay and Surat ;

(*iii*) valid for drawing a segment but not for drawing a circle.

An achievement test in science may be—

(*i*) valid for Std. VIII and not for Std. X ;

(*ii*) valid for Std. VIII in Maharashtra State but not valid for the same standard in Gujarat State ;

(*iii*) Valid for Std. VIII in an urban area but not valid for the same standard in any rural area.

Types of Validity

The following four types of validity have been identified and are commonly used in educational and psychological measurements :

(*i*) **Content validity** (how well our test sample represents the universe of criterion behaviour) ;

(*ii*) **Concurrent validity** (how closely test scores are correlated with present criterion behaviour) ;

(*iii*) **Predictive validity** (how well test scores predict future criterion behaviour) ;

(*iv*) **Constructive validity** (how well our test seems to measure a hypothesised trait).

Relation Between Validity and Reliability

(*i*) Validity is sometimes defined as truthfulness while reliability is sometimes defined as trustworthiness. Truthfulness and trustworthiness are the two aspects of what is essentially the same thing, namely, test efficiency.

(*ii*) In order that a test should be valid, it must first of all be reliable. If we cannot get a scale to give us a consistent weight measure, we certainly cannot expect it to be accurate. Note, however, that a measure might be very consistent (reliable) but not accurate (valid). A scale may record weights which are 10 gm. too heavy each time. In other words, reliability is a necessary but not sufficient condition for validity. A reliable test may not necessarily be valid ; but a test cannot be valid unlesss it is reliable.

(*iii*) Neither validity nor reliability is an *either*. They are degrees of each.

(*iv*) Since a single test may be used for many different purposes, there is no single validity index for a test. A test that has some validity for one purpose may not at all be valid for another. But for a test a single reliability coefficient may be estimated by statistical procedures.

(*v*) Validity includes reliability. A classroom test should be both consistent and relevant ; this combination of characteristics is called validity. Thus, validity has two major aspects – reliability and relevance.

Factors Affecting Validity

All the factors affecting reliability will naturally affect validity. Moreover, the following points influence the validity of a test :

(*i*) **Unclear direction** : If directions do not clearly indicate to the pupil how to respond to test items, the validity of a test is reduced. For example,

Unclear : State whether the following statements are true or false. Give reasons.

Clear : State whether each of the following statements is true or false. If false, give reasons.

(*ii*) **Reading vocabulary** : If the reading vocabulary is poor the students fail to reply to the test item, even if they know the answer. It rather becomes a reading comprehension test for them, and the validity decreases.

(*iii*) **Difficult sentence construction** : If a sentence is so constructed as to be difficult to understand, students would be unnecessarily confused, which will affect the validity of the test. For example,

> "Carefully select the material to be interpreted so that the interpretation to be made will not be insignificant and non-representative of the course content and non-behavioural objectives."

(*iv*) **Poorly constructed test items** : Poorly constructed test items reduce the validity of a test. For example,

Poor : The capital of India is—.

There are many correct answers to this test item ; *e.g.*, (*i*) ... in the northern part of India ; (*ii*) ... where the Prime Minister lives ; (*iii*) ... a well known historical place ; etc.

(*v*) **Use of inappropriate items** : With the help of objective type items, the pupils' power of organising matter cannot be judged. By written test items the pupils' correct pronunciation cannot be judged. The use of such inappropriate items lowers validity.

(*vi*) **Medium of expression** : English, as the medium of instruction and response for non-English medium students, creates many serious problems. Such tests through the English medium, instead of measuring learning outcomes in a subject, measure primarily the knowledge of English, which ultimately affects the validity of a test.

(*vii*) **Difficulty level of items** : Too easy or too difficult test items would not discriminate among pupils ; thereby the validity of a test will be lowered.

(*viii*) **Influence of extraneous factors** : Extraneous factors, like the style of expression, legibility, mechanics of grammar (spelling, punctuation, etc.) handwriting, length of the answer, method of organising the matter, etc., influence the validity of a test. If a student gets a higher score because of his ability to draw artistic diagrammes in science, the score does not tell the whole truth about his achievement in science ; hence the test is not valid. Lack of neatness, while answering a test item in algebraic equations, should not influence the score.

(*ix*) **Inappropriate time limit** : In a speed test, if no time limit is given, the results will be invalidated. In a power test, an inappropriate time limit will lower its validity. Our tests have become power tests as well speed tests. Hence, much care should be taken in fixing the time limit.

(*x*) **Inadequate coverage** : Eassy type items generally fail to cover a vast portion of the content. Inadequate sampling lowers validity.

(*xi*) **Inadequate weightage** : Inadequate weightage to sub-topics or objectives or various forms of questions would call into question the validity of a test.

(*xii*) **Quiz items** : Sometimes students, because of their inability to understand a test item, guess and respond. This would lower the validity of the test item ; *e.g.*, (*i*) Comment : Life minus science is zero ; (*ii*) Explain : Modern Mathematics – a New Dimension.

Thus, whenever a test measures something other than what it is supposed to, its validity goes down.

IV Objectivity

A test is objective when the scorer's personal judgement does not affect the scoring. Objectivity in a test makes for the elimination of biased opinion or judgement of the person who scores it. A measuring instrument is said to be highly objective if the score assigned by different but equllay competent scorers is not affected by the judgement, personal opinion or bias of the scorers.

In an objective test, test items can readily be scored as right or wrong. The true-false type, the alternate response type, the matching type, the multiple-choice type test items are highly objective, while essay type items are highly subjective.

Objectivity is a pre-requisite of reliability and therefore of validity. Objective judgements are accurate and hence tend to be reliable. But this does not mean that only objective type test items should be used and short-answer or essay type test items should not be used at all. The most important thing is to make the evaluation tool as objective as possible.

The objectivity of a test can be increased by –

(*a*) using more objective type test items ;

(*b*) making essay type test items more unambiguous, well constructed, giving specific directions which would establish a framework within which students can operate ;

(*c*) preparing a marking scheme or a scoring key ;

(*d*) setting realistic standards ;

(*e*) asking two independent examiners to evaluate the test and using the average score of the two as the final score.

The objectivity as well as the reliability and validity of a test may be expressed with the correlation coefficient. The coefficient of correlation between scores assigned to a group of papers by the same examiner on two occasions is called the *coefficient of objectivity.*

V Discriminating Power

The basic function of all educational measurement is to place individuals in a defined scale in accordance with differences in their achievements. Such a function implies a high discriminating power on the part of a test. Since tests are made up of separate items, it is clear that each item must have this quality in a maximum degree if the total test is to possess it. This quality of a test directly affects its validity.

A good measuring instrument should detect or measure small differences in the achievement of students and thus discriminate between the good and the bad students.

The discriminating power of a test item refers to the degree to which it discriminates between good and bad students in a given group. This suggests that pupils with superior ability should answer the item correctly more often than pupils who do not have such an ability.

The method used for estimating discriminating power is discussed in the next chapter.

VI Adequacy

A measuring instrument should be adequate ; *i.e.* balanced and fair. The test should include items, measuring both the objectives and the content. Care should be taken to ensure that one objective or content area is not overtested at the expense of other objectives or areas. Here, a blueprint will be very useful.

Again, a test should be fair. To trick an examinee is to cheat him. A test built on deceptions, such as verbal tricks, ambiguous and unspecified expections, is not fair to anyone. Lack of fairness can result from two sources, *viz.*, trick items and teacher bias. The following true-false test item illustrates a trick item.

"The highest mountain in the world is Mt. Eveready."

Such items measure reading detail rather than content achievement.

Teacher bias affects testing during both the construction and the scoring stages. A teacher may constantly use language forms or genaral concepts in test items which favour one group of examinees against another.

These factors, and many others which impinge upon the testing situation, affect the fairness of the test. In short, adequacy is a pre-requisite of reliability as well as for validity.

VII Practicality (Usability)

Practicality is an important criterion for assessing the value of a test ; and it depends upon a number of factors.

(A) Ease of Administrability

(*i*) Definite provision should be made for the preparation, distribution and collection of test materials.

(*ii*) Instruction to the pupils should be simple, clear and concise.

(*iii*) Sample items should be illustrated by practice exercises.

(*iv*) The test format should be such that pupils will have no difficulty in reading the items, in recording their answers, in moving from one page to the next, etc.

(*v*) Illustrations should be clearcut and easily tied up with the appropriate test items.

(*vi*) Mechanical features of a test, such as page size, length of line and kind of type, should be such as to facilitate the administration of a test.

(B) Ease of Scoring

(*i*) The results of a test possessing scorability should be obtainable in as simple, rapid and routine a manner as in proportion to their importance.

(*ii*) The test should be subjected to accurate scoring even by persons not conversant with their content.

(*iii*) No algebraic manipulations should be required to get the scores.

(C) Ease of Interpretation

(*i*) The raw scores of a test should be easily converted into meaningful derived scores.

(*ii*) It should be feasible to interpret the results with the competence of classroom teachers. No specially trained personnel should be required in order that the results may be interpreted validly.

(D) Economy

(*i*) The economy of a testing programme should be computed in terms of the validity of the tests per unit of cost.

(*ii*) Economy refers to the cost as well as the time required for administering and scoring a test. Any test of a duration which does not exceed a period of 45 minutes is preferred by teachers.

VIII Comparability

A test possesses comparability when scores resulting from its use can be interpreted in terms of a common base that has a natural or accepted meaning. There are two means whereby comparability of results is established for standardised tests :

(*i*) Availability of equivalent (Parallel) forms of a test ;

(*ii*) Availability of adequate norms.

IX Utility

A test possesses utility to the extent to which it satisfactorily serves a definite need in the situation in which it is used. The utility of teacher-made tests depends largely upon the foresight of the teacher in so planning the test and its use that the results will serve the needs of the local classroom.

Utility, in a sense, may be considered as the final master criterion. It is certainly not entirely distinct from the other criteria, but it may be an effective final check on the value of test.

Evaluate Yourself

1. What are the characteristics of a good measuring instrument ?
2. Define :
   (*a*) Validity ; (*b*) Reliability ;
   (*c*) Objectivity ; (*d*) Discriminating power.
3. Bring out the relationship between the reliability and validity of an instrument by giving illustrations.
4. What are the factors that influence each of the following :
   (*a*) Validity ; (*b*) Reliability ; (*c*) Objectivity ?
5. Explain clearly the difference between a speed test and a power test.
6. How will you increase the practicality of a test ?

12

Interpretation of Test Results

12.1. After Testing—What ?

A test has been administered and scored. The pupils have been given their scores. The job is done. Or is it ? The wise teacher might begin to think—But was it a good test ? It must have been. Before constructing the test, the objectives, the content, the forms of questions were carefully considered ; the blueprint was also prepared. Each item was carefully constructed. But *was* it a good test ? *Was* the result intelligible ? *Was* it misinterpreted or misapplied or not applied at all ?

Perhaps, at this point, the teacher computes the coefficient of reliability of the test he asks. It is a fairly reliable test. But, how can I improve the test ? If I wanted to use some of the items again, which items should I use ? Certainly, I would question the item which my better pupils missed and my poorer pupils got correctly. Also, if the item is so difficult that nearly all of my pupils missed, or so easy that nearly all got it correctly, would the item help me to discriminate between pupils on the basis of the their knowledge in the area tested ?

The following questions may now be asked ?

(*a*) What did the test scores mean ?

(*b*) How difficult was each item for the class ?

(*c*) To what extent did each item discriminate between the better and the below-average pupils ?

The discussion in this Chapter is based on these questions.

12.2 Interpretation of Test Scores.

Test scores are valuable to the classroom teacher to the extent that they can be interpreted. The measurement of individual performance by means of tests is usually expressed as a score, which may be in terms of the time taken to complete a task or the work done in a given period of time. Less often, scores are expressed in terms of the difficulty of a task or the excellence of a result.

In physical sciences, scores are expressed in equal units and are also taken from a true zero. They constitute *ratio scales*. Scores in C.G.S. scale may be added, subtracted, multiplied or divided. Again, a score of 32 cm is twice the score of 16 cm ; a weight of 10 kg. is half the weight of 20 kg ; a period of 24 minutes is exactly two-thirds of a period of 36 minutes.

In behavioural sciences, many psychological and educational tests are not scaled in equal units, nor are they taken from a true zero. These are *interval scales*. They cannot be added or subtracted, multiplied or divided. A person having 120 IQ cannot be said to be twice as intelligent as a person having 60 IQ, because neither score is taken from a true zero of "no intelligence." A student having a score of 60 in Arithmetic cannot be said to be thrice as good as a student getting a score of 20, because neither score is taken from the true zero of "no knowledge of Arithmetic."

A teacher generally assigns marks (scores) to students. Suppose Manish gets 50, 62 and 90 marks in History, Gujarati, and Mathematics respectively. These marks cannot be added because one mark in History is not the same as one mark in Gujarati, nor is one mark in Gujarati the same as one mark in Mathematics.

Let us assume that Shakuntala obtains 56 marks in Hindi and Neelam 48. We generally say that, in Hindi Shakuntala is better than Neelam. But this interpretation is not only unscientific but unreasonable as well. The marks obtained in one subject by two students of different classes or schools where two teachers—having different abilities, knowledge, understanding, skill, attitude, etc. have taught the subject, cannot be and should be directly compared. This fact should be remembered by teachers, administrators and parents.

Raw Scores

Students' scores in a test have little or no meaning except to indicate the relative position of each student in the class in each section of the test. Such untreated scores are known as raw scores.

> A raw score is simply the number of points received in a test when the test has been scored according to instructions.

A student's raw score in one section of a test is not directly comparable to his raw score in another section, which may have a larger or smaller number of items of greater or less difficulty. Assume that Rahul, a Ninth Grade boy, has obtained the following raw scores in a terminal test :

	English	Geography	Science	Drawing	Physical Training
Raw scores	56	45	56	70	38

These data, in and of themselves, tell us nothing about how Rahul compares with others of his own age since we have no idea how other children have scored. But do they even tell us that Rahul is better in one subject area than another ? No, because we do not know the total number of test items in each subject, nor do we know whether some tests have easier items than the others. Some types of derived scores are necessary for both inter-and intra-individual interpretation.

Derived Scores

Before raw scores can be used to appraise a student's relative strength and weaknesses, they must be expressed in comparable units. In other words, they must be translated into derived scores.

> A derived score is a numerical report of test performance in terms of the pupil's relative position in a clearly defined reference ground (norm group).

Derived Scores Show

(*a*) how a student's performance in the test compares with some arbitrary standard such as a perfect test score ; or

(*b*) how his score compares with the scores of others in his class, his school or some other group with whom he can appropriately be compared.

To know how a student's score compares with the mean score of a clearly defined reference group (norm group) is of great value. If one has an indication of the variability of the distribution of scores in the norm group as well, much more information can be obtained. If a student's raw score is changed into a score that by itself gives normative or relative information, we can present the information more efficiently.

Derived scores are useful

(*i*) in comparing a student's score to those of others ; *i.e.*, in making inter-individual comparisons ;

(*ii*) in making intra-individual (within individuals) comparisons ;

(*iii*) in assisting in a meaningful combination of data.

At times, one wants to combine various pieces of information (*e.g.*, results of term papers, tutorials, tests, etc.) to make a single decision about the final grade of an individual. By converting all into scores derived scores, a weighting scheme may be carried out.

Converting raw scores into derived scores is simple with standardised tests. All we need to do is to refer to the table of norms and find out the derived score which corresponds to a student's raw score. In the case of standardised tests, a derived score is generally a numerical description of a student's performance in terms of norms such as mental age, intelligence quotient, reading age, etc.

Norms

Norms are the scores earned by pupils in clearly-defined reference groups. These groups are known as *norm groups* and are generally representative of the pupil population. There are different types of norms, such as age norms, grade norms, percentiles, standard scores and quotients (*e.g.*, intelligence quotient, educational quotient, etc). Norms are not standards ; they go on changing from population to population.

As far as teacher-made tests and the daily work of the classroom teacher are concerned, the highly statistical procedures of finding out norms or comparing the raw scores with the norms, are not very useful, and hence beyond the scope of the book.

12.3 Item Analysis

When an item-writer prepares test items, he must come to some judgements regarding the difficulty level, discrimination power and content validity of his items. Normally, the item-writer can reach some decisions about content relevance ; but an assessment of difficulty and discrimination indices require some quantitative evidence. There are many instances of professional item-writers having misjudged the difficulty of their test items. If this can happen with professionals, we should expect that classroom teachers, for a variety of reasons, will make invalid estimates of the psychometric properties of their test items. This is why some quantitative evidence in support of the difficulty and discrimination indices of test items must be obtained. Such estimates can be obtained from item analysis.

Again, many teachers fail to re-use test item. This is indeed unfortunate, for a teacher should not fail to re-use his better test items or improves poor items in subsequent tests. The time, effort and energy expended in the planning and writing of test items is wasted if good items are discarded. It is ridiculous for teacher to have to write new items every time they prepare a test. Over a period of time, they should build up a test file of the better items to be re-used. However, in order to build this test file, it is necessary to know how an item behaves.

A test should be neither too easy nor too difficult ; and each item should discriminate validity among the high- and low-achieving students. The procedure used to judge the quality of an item is called *item analysis*, which is a process of examining a student's response to each test item. Specifically, what one looks for is the difficulty and discriminating ability of an item as well as the effectiveness of each alternative.

Steps Involved in Item Analysis

In conducting an item analysis of a classroom test, one should bear the following points in mind :

(*i*) Arrange answer books (or answer sheets) from the highest score to the lowest score.

(*ii*) From the ordered set of answer books, make two groups. Put those with the highest scores in one group and those with the lowest scores in the other group. (There are some statistical reasons why one should place the best 27% of the answer books in one group and the poorest 27% in the other group. But, for classroom tests, it is really not important what percentage is used. If the class is small, say, of 50 or fewer students, there would be too few answer books in the top and bottom 27% to yield a very reliable item analysis indices). In a typical type of classroom situation, it is quite appropriate to divide the total group into the top and bottom halves.

(*iii*) For each item (*e.g.*, true-false type, completion type), count the number of students in each group who answered the item correctly. For alternate-response type of items, count the number of students in each group who choose each alternative.

(*iv*) Record the count for each item. Assume a total of 40 answer books, 20 in each group. Below is given a hypothetical illustration :

Item No.	1	2	3	4	5
No. of correct responses of the best 20 (or upper 27% or top half)	12	15	20	3	6
No. of correct responses of the poorest 20 (or lower 27% or bottom half)	3	12	0	3	12
Omits	0	4	0	0	10

Estimating Item Difficulty

For each item, compute the percentage of students who get the item correct. This is called the *Item Difficulty Index*. The formula for item difficulty index is :

$D = \frac{R}{N} \times 100$ where R=Number of pupils who answered the item correctly ;

N=Total number of pupils who tried them.

For item No. 1, the Difficulty Index$=\frac{15}{40}\times 100=37.5\%$ or 0.376

For item No. 2, the Difficulty Index$=\frac{27}{36}\times 100=75\%$ or 0.75

For item No. 3, the Difficulty Index$=\frac{20}{40}\times 100=50\%$ or 0.50

For item No. 4, the Difficulty Index$=\frac{6}{40}\times 100=15\%$ or 0.15

For item No. 5, the Difficulty Index$=\frac{18}{30}\times 100=60\%$ or 0.60

It may be noted that the higher the difficulty index, the easier is the item. Some prefer to express a difficulty index in decimals rather than as a percentage. In that case, one would only compute R/N.

What is the ideal difficulty index ? What is the ideal discrimination index ? Teachers would like their classroom achievement tests to have an appropriate difficulty index because test difficulty is related to discrimination power. If an item is too easy or too hard, it cannot discriminate at all and adds nothing to test reliability or validity. The designation of the ideal difficulty level arises out of many factors, the most important being the objectives of the test and the type of objective items used.

There is a general agreement among administrators of tests that the normal curve may be taken as a guide in the selection of difficulty indices. Thus half of the items may have difficulty indices between 25% and 75%, one-fourth indices larger than 75% and one-fourth smaller than 25%. An item having 0% or 100% difficulty index has no discriminating value ; but such an item may be included in a test solely for psychological effect. V.9

In the long run, what is more important than the level of difficulty is to have a test that possesses an adequate content validity. In addition, we want a test in which, for each item, a larger proportion of the better able than the less able students can answer the item correctly.

Other things being equal, the more positive and usually more profitable approach to increase test difficulty is to have more items calling for the application of the higher mental processes, such as application of principles, understanding of concepts, analysis, synthesis and the like.

Estimating Discrimination Index

The discriminating power (*i.e.*, the validity index) of an item refers to the degree to which a given item discriminates among students who differ sharply in the function(s) measured by the test as a whole.

An estimate of an item's discrimination index may be obtained by the formula :

$$\text{Discrimination Index}=\frac{R_U-R_L}{\frac{1}{2}N}$$

Where R_U=No. of correct responses from the upper group ;

R_L=No. of correct responses from the lower group ;

N=Total number of pupils who tried them.

For item No. 1, the Discrimination Index$=\frac{12-3}{\frac{1}{2}(40)}=0.45$

For item No. 2, the Discrimination Index$=\frac{15-12}{\frac{1}{2}(36)}=0.16$

For item No. 3, the Discrimination Index$=\frac{20-0}{\frac{1}{2}(40)}=1.00$

For item No. 4, the Discrimination Index$=\frac{3-3}{\frac{1}{2}(40)}=0.00$

For item No. 5, the Discrimination Index$=\frac{6-12}{\frac{1}{2}(40)}=-0.30$

From the discrimination point of view, item No. 3 is the best, item No. 1 is good and item No. 2 is poor. The Item having zero or negative discrimination index must be discarded or revised.

A discrimination index is usually expressed as a decimal. If it has a positive value, the item has positive discrimination. This means that a larger proportion of the more knowledgeable students than poor students got the item correct. If the value is zero, the item has zero discrimination. This can occur :

(*i*) because the item is too easy or too hard ; or

(*ii*) because it is ambiguous.

If more bad students than good stutdens get the item correct, one would obtain a negative discrimination. With a small number of students, this may be a chance result ; but it may indicate the item is ambiguous or mis-keyed.

In general, the higher the discrimination index, the better the item. For classroom tests, where one divides a class into upper and lower halves, as we have done, one would hope that most of the items would have discrimination indices above .20 (if one uses the upper and lower 27%, one should expect higher values, since there is a greater difference between the groups).

Effectiveness of Distractors

Record the count as follows for each item. Assume a total of 40 answer books, 20 in each group. Below is given a hypothetical illustration, in which the asterisk indicates the correct answer :

	Alternatives					
	A	B*	C	D	E	omits
Upper group (20 students) :	0	12	0	0	8	0
Lower group (20 students) :	8	3	7	0	2	0

Look at how the distractors (incorrect options or alternatives) work by using the same process specified above. For the distractors, we hope to get *negative* values. That is, more bad students than good students should choose incorrect answers.

Quite often, a visual inspection is all that is needed to evaluate the effectiveness of the distractors, and there is no need to calculate an index of effectiveness.

In the illustration, alternatives A and C are effective in the sense that they attract more students from the lower group than from the upper group. But alternative D is a poor distractor because it attracts no one and therefore is useless. The item has only for options, and the chances of success by mere guessing are enhanced. Alternative E is also poor because it attracts a higher proportion of the good than of bad students. The item-writer must ask himself : "Why were the brighter students attracted to E ? Was it because of ambiguity ? Was it because there were two equally correct answers ?" In short, this item should be revised by changing the alternatives D and E.

	Alternatives					
	A	B	C	D	E*	omits
Upper Group (20 students) :	0	1	7	2	4	6
Lower Group (20 students) :	0	1	5	3	6	5

This is a poor item because more students from the lower group than from the upper group choose the correct answer. The item is discriminating in a negative direction. In view of the other alternatives, this item should be rejected.

12.4. Interpreting Item Analysis Data

Item analysis data should be interpreted with caution.

Remember that :

(*i*) Item analysis data are not analogous to item validity ;

(*ii*) The discrimination index is not always a measure of item quality ;

(*iii*) Item analysis data are tenative ;

(*iv*) Avoid selecting test items purely on the basis of their statistical properties.

12.5 Using Items Analysis Results

Item analysis data have several values :

(*i*) They help one judge the worth or quality of a test ;

(*ii*) They can be of aid in subsequent test revisions ;

(*iii*) They lead to increased skill in test construction ;

(*iv*) They provide diagnostic value and help in planning future learning activities ;

(*v*) They provide a basis for discussing test results ;

(*vi*) If students assist in, or are told the results of, item analysis, it can be a learning experience for them ;

(*vii*) They help in revising the test or test items.

Evaluate Yourself

1. Explain the terms *ratio scales* and *interval scales.*
2. Define : (*i*) Raw Scores ; (*iii*) Derived Scores.
3. What is the importance of derived scores ?
4. Which different steps are involved in item analysis ?
5. Find out the difficulty index and the discrimination index for each item given in the following Table :

Item No.	1	2	3	4	5	6	7	8	9	10
No. of correct responses of the best 30 (or upper 27% or top half)	24	15	20	12	30	5	18	10	25	8
No. of correct responses of the poorest 30 (or lower 27% or bottom half)	5	15	6	20	0	5	10	10	24	3
Omits	0	0	4	5	0	2	0	4	0	0

6. In the case of the following data, comment on the effectiveness of the distractors (the asterisk indicates the correct answer) :

(*i*)	*Alternatives*					
	A*	B	C	D	E	omit
Upper group (24 students)	15	0	6	3	0	0
Lower group (24 students)	15	0	2	2	5	0

	Alternatives					
(*ii*)	A	B*	C	D	E	omit
Upper group (32 students)	0	28	2	0	2	0
Lower group (32 students)	10	8	6	6	2	0

7. What points will you bear in mind while interpreting item analysis data ?
8. What are the values of item analysis data ?
9. Write short notes on : (*i*) raw score and derived score ;
   (*ii*) item analysis.
10. Justify : The teacher's job is not completed when he completes the assessment of answer books."

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(*vi*) provide immediate feedback for the teacher, who can then decide whether a particular unit or concept needs re-teaching and/or whether individual pupils are in need of remedial instruction ;

(*vii*) provide for an economic use of class time as all pupils are simultaneously given information about themselves ;

(*viii*) provide information which is the basis for a report on the progress of students ;

(*ix*) are more relevant to a teacher's particular objectives. The classroom teacher can *tailor* the test to fix his particular objectives, and also make the test *fit* the class and even the individual pupils ;

(*x*) are more likely to reflect today's curriculum ;

(*xi*) help the teacher to develop more efficient teaching strategies ;

(*xii*) can be used to obtain as much information as possible about any single aspect of the content area such as reflection, magnetism, water, physical features of India, set theory, etc., having a limited purpose.

13.3 Deficiencies in Teacher-made Tests and Testing

Visit a school holding a test. After the completion of the test, while coming out from the examination hall, one can hear the students complaining and making one or more of the following remarks :

(*i*) We are fed up with tests that are ambiguous, unclear and irrelevant.

(*ii*) It was an exercise in futility.

(*iii*) I did not know what the teacher was looking for.

(*iv*) I studied the major details of the course, but was only examined in trivia and footnotes.

(*v*) Many questions have been set from last year's question paper.

(*vi*) The paper was so lengthly that I could not attempt even half of the questions.

(*vii*) We were tested on minute, mundane facts.

(*viii*) The material in which we were tested was not covered in class, nor is it in the text.

By and large, teacher-made achievement tests are quite poor. Let us briefly look at some of the major deficiencies commonly

13

The Classroom Testing

TEACHER-MADE TESTS—I (ESSAY TYPE)

13.1. Teacher-made Tests

Teacher-made tests are frequently the basis of evaluating the students' progress in school. Although the specific purposes of tests and the intended use of the results may vary from one school to another or from one teacher to another, it is essential that we recognise the value of test results in the life of students, parents, teachers and other administrators and educators.

Classroom evaluation instruments should not be restricted to the conventional pencil-and-paper achievement tests. Some of the more important instructional objectives cannot be evaluated by these tests. We should use rating scales, check lists and other observational techniques as well.

13.2 Why Teacher-made Tests ?

Teachers have an obligation to provide their students with the best instruction possible. This implies that they must have some procedures whereby they can reliably and validly evaluate how effectively their students have been taught.

Teacher-made tests are valuable because they—

(*i*) assess comprehensively the extent and degree of students progress (ability and achievement) with reference to specific classroom activities ;

(*ii*) are simple to use ;

(*iii*) motivate the students ;

(*iv*) permit the teacher to ascertain an individual pupil's strength and weakness and his needs ;

(*v*) provide for continuing checking (continuous evaluation) ;

associated with teacher-made achievement test and testing ; *i.e.*, the present-day examination system.

It hardly needs elaboration that examinations, as they exist today, are not as effective as they should be. The need for their reform has been expressed for long but very little was done other than the establishment of the Central Examination Unit in 1958. Examination reform was given the highest priority by the Radhakrishnan Commission, which stated that "if we are to suggest one single reform in University education, it should be that of the examination."

Our present-day examination system primarily suffers from the following defects :

I. With Reference to Objectives

(*i*) Only the knowledge-objective is taken care of. Other important objectives such as understanding, application of knowledge and understanding, skill, etc., are ignored.

(*ii*) Only content, rather than the objectives and learning experiences, is kept in mind while testing.

(*iii*) An examination is considered as an end and not as a means.

(*iv*) Passing the examination is the only objective for students. This leads to—

- (*a*) copying ;
- (*b*) other malpractices such as reading guides ;
- (*c*) chance element (guessing questions) ;
- (*d*) learning the questions by heart ;
- (*e*) making students nervous, fearful.

(*v*) Weightage is given to the memorisation ability of students.

II. With Reference to Questions

(*vi*) Mostly essay type, non-comprehensive and ambiguous questions are set. Students interpret them differently. This leads to subjectivity in answering and assessing.

(*vii*) Certain typical questions are repeated. This leads to (*a*) guessing ; therefore there is a chance element in them ; (*b*) learning by heart ; (*c*) cramming rather than thinking.

(*viii*) Inappropriate item formats are used.

III. With Reference to Structure of Examination

(*ix*) Overall options are provided. This may lead to—

(*a*) freedom to prepare only selected topics and leave out rest without any serious risk ;

(*b*) confusion even for the bright students in selecting questions.

(*x*) Only written type examination is conducted. Other types such as oral, observational performance type, etc., are ignored.

(*xi*) Unit tests are introduced at present in high schools. But these tests are not unit tests in the true sense.

(*xii*) Terminal and annual examinations continue to enjoy undue weightage. At present if an average student appears only at the terminal and annual examinations, he can very easily pass and become eligible for promotion to the higher standard.

IV. Other Defects

(*xiii*) Examinations dictate to the teacher what to teach and how to teach a subject. What is important in the examination is given undue importance in classroom teaching.

(*xiv*) For slow writers, present-day examinations are a sort of speed tests rather than power tests. In short, examinations are usually inadequate tests.

(*xv*) The passing standard is quite low.

(*xvi*) A pupil's progress is reported only in terms of raw scores. This is quite unfair for comparison purposes.

(*xvii*) Only the quantitative judgement is taken care of. Qualitative judgement is quite ignored.

(*xviii*) Teachers are unable to identify the strength and weaknesses of their own teaching.

The present-day examination system ultimately results in—

(*i*) a tremendous wastage of human resources ;

(*ii*) the belief that a teacher is good, if and only if, he brings good results ;

(*iii*) the fact that a school becomes only an information centre where the subject is at the centre rather than the child ;

(*iv*) the failure of higher achievers in life ;

(*v*) the non-development of good qualities, such as honesty leadership, followership ;

(*vi*) an encouragement of students to join tuition classes or read guides.

A few suggestions may be made to remove the defects of present-day examination system

(*i*) We should improve our questions Those questions which promote thinking should be asked. They should be pointed, and their wording should be specific.

(*ii*) We should evaluate the achievement of the various objectives directly and the content indirectly.

(*iii*) Unit tests in the true sense of the term should be introduced.

(*iv*) Different types of tests, to check the achievement of various objectives, should be given a prominent place in the testing programme.

(*v*) The passing standard should be high.

(*vi*) All the three judgements—quantitative judgement, qualitative judgement and value judgement—should be given their due place in the testing programme.

13.4. Classification of Teacher-made Tests

There are a variety of ways in which teacher-made tests can be classified. The classification may based upon—

(*i*) **Item format** : eassy versus objective ;

(*ii*) **Presentation of stimulus material** : verbal versus non-verbal ;

(*iii*) **Purposes and uses of tests** :

(*a*) criterion-referenced versus norm-referenced ;

(*b*) achievement versus performance ;

(*c*) formative versus summative.

It should be recognised at the outset that these classification schemes are not mutually exclusive.

Classification by Item Format

Here, the item types are classified into two major categories—essay and objective. The short-answer form is placed under *objective* rather than *essay*. It is really a compromise between the essay and other types of objective items. Short-answer items, like essay items, require recall (supply) rather than recognition (selection) skills, but they permit less freedom of response than the essay questions. Also, short answer items can be scored more objectively than essay questions.

It is not possible to classify tests solely on the basis of whether or not subjectivity is involved. Subjectivity is involved when *any* test is constructed depending upon—

—the purpose(s) of the test ;
—the kinds of questions to ask ;
—the difficulty level of the test ;
—whether or not a correlation formula should be used.

Hence, one *cannot* say that an objective test does not involve some degree of subjectivity on the part of the test-maker. At any rate, the essay type and the objective type tests do differ quite markedly in the degree to which they are amenable to objective scoring.

How to be a good Item-writer ?

The process of writing good valid test item is not so simple—it requires 1. effort 2. time .. certain skills and proficiencies.

To be a good item-writer, one should be proficient in the following areas :

1. Know and understand the subject-matter thoroughly

The greater the item-writers' knowledge of the subject matter, the greater the likelihood that he will know and understand both facts and principles as well as some of the popular misconceptions. This later point is very important specially when he writes selection of items in general and the multiple choice items in particular. This type is because the item-writer must supply plausible although incorrect distractors.

2. Know and understand the pupils being tested

The kinds of pupils the teacher deals with will determine in part the kind of item format, vocabulary level and level of difficulty of the teacher-made test.

For example : (1) Primary and Secondary teachers seldom use Multiple choice items because young children are better able to respond to the Short-Answer type.

2. The vocabulary level used for a class of gifted children may be very different from that used with a class of educable but mentally retarded children.

The class-room teacher who knows and understands his pupils will generally establish more realistic objectives and develop a more valid evaluating device than will the teacher who fails to consider the characteristics of his students.

3. Be skilled in verbal expression

Some of the major problems or deficiencies of teacher-made achievement tests are related to problems of communication—1.

ambiguous wording, 2. poor choice of words and 3. awkward sentence structure.

The item-writer must be scrupulously careful at expressing himself verbally. It is essential that the item-writer clearly convey to the examinee the intent of the question. In an oral examination, the pupil may have the opportunity to ask for and receive clarification of the question. In the traditional class-room paper and pencil test, this is not possible.

4. Be thoroughly familiar with various item formats

The item-writer must be knowledgeable of 1. the various item formats—their strength and weaknesses, the errors commonly made in writing this or that type of item. 2. the guidelines that can assist him in preparing better test item.

I. Essay Type

- (*a*) Discussion or extended response ;
- (*b*) Short-answer or restricted response ;
- (*c*) Oral.

II. Objective Type

(A) Supply-type items

- (*a*) Short answer :
  - (*i*) Single word, symbol, formula ;
  - (*ii*) Multiple words or phrases ;
- (*b*) Completion (fill up the blanks).

(B) Selection Type Items

- (*a*) Alternate response : true-false, yes-no, right-wrong ;
- (*b*) Multiple-choice ;
- (*c*) Matching.

(C) Context-dependent Type Items

- (*a*) Pictorial ;
- (*b*) Interpretative.

Classification by Stimulus Material

It is generally thought of in terms of a series of verbal problems that require some sort of verbal response. There are many instances, however, where the stimulus material used to present the problem to the student is not necessarily verbal. For example, in the humanities or an Art course, stimulus materials can be pictorial. Although non-verbal stimulus items are infrequently used in the classroom, this does not mean that they are not a good medium to use.

Classification by Purposes

(A) Criterion versus Norm-referenced

The test score in a criterion-referenced interpretation is used to describe the status of the individual. For example,

(*i*) Does Manish know how to add three-digit numbers ?

(*ii*) Does Kishan know how to balance a chemical equation ?

A norm-referenced interpretation of the test score permits the teacher to make meaningful comparisons among students in terms of their achievement. For example, in a class of 60 students, the average marks in Mathematics are 42. Shakuntala's marks in Mathematics are 48. The teacher concludes that Shakuntala's performance in Mathematics is above average.

(B) Achievement versus Performance

Education is concerned both with (*a*) what we know in an academic sense in such areas as reading, science, social studies, or Mathematics, and (*b*) how well we are able to apply our knowledge in such areas as art, music, painting, woodwork, etc. For the first aspect, achievement tests are in use and, for the second one, the performance tests.

(C) Formative versus Summative Evaluation

The item format used and the types of items written do not generally differ for tests used for formative and summative evaluation. What does differ is the blueprint and the frequency of testing. Since formative evaluation is designed to provide the teacher with continuous and immediate feedback so that he can govern his instructional strategy, teachers will test more frequently. With respect to the blueprint, there will be a very thorough sampling of a limited content area, whereas in summative evaluation there will be a more restricted sampling across a large content area.

Formative and Summative Evaluation

"Although it may not be a good practice to assign a summative grade for affective behaviour, it is often desirable to evaluate a student's affective behaviour formatively."

The term *summative* refers to assigning a grade for student's achievement at the end of a term, course or instructional programme.

The term *formative* denotes the on-going or systematic assessment of student achievement while the term, course or instructional programme is in progress.

Feed-back to the students, not the assignment of a grade, should be the purpose of making a formative evaluation of affective objectives.

The gathering of data during the time of programme (curriculum evaluation, preparing unit plan, writing items, class-room testing etc.) is being developed for the purpose of guiding the developmental process is formative evaluation.

A person who is continually evaluating his programme will find many things that can be changed for the better during the operation of the programme. Most educators would feel it unprofessional not to make these improvements even though they may upset the research design.

Formative Evaluation (feedback)

Formative evaluation (informing students of their progress during the instruction) is most helpful for the immediate decision-making that students face.

The daily interaction between teachers and students should result in the students having fairly good knowledge about the quality of their achievements necessary for immediate decision-making.

Of course, this depends upon the teachers skill in daily feedback. Effective feedback depends upon 1. *determining* upon what a student needs to know to facilitate further learning, (2) *gathering* accurate data and (3) *presenting* these data to the student in a fashion he will comprehend.

Summative Evaluation

Making overall assessment or decision with the programme is a summative evaluation. Although formative evaluation is perhaps most helpful to the student, summative (or terminal) evaluation of the kind provided at periodic marking periods also can assist him in his decision-making—particularly in the formation of long range plans. Pupils can't easily combine all the daily feedback provided and obtain an overall picture of how they are doing. They need the insight teachers can provide. Thus, an overall summary is of value.

For example : it is not enough for a student in a Mathematics course to know :

—that his drawing figures was weak while his grasp of concepts was strong,

—that he was high on understanding of trigonometry but low on understanding of geometrical construction,

—that he was an average in arithmetical calculations.

But he will want to know what it all adds up to—whether all things considered, he did 'well' or 'poorly'. The grade helps a student decide whether Mathematics is a field in which further inputs of his resources are likely to be productive for him.

13.5 The Written Test

The test in which the students respond to the teacher in writing is called a written test. It has both advantages and disadvantages.

Advantages

(*i*) It gives us a most stable, reliable and valid type of evaluation.

(*ii*) It can be planned carefully, keeping in view objectives, content and learning experiences.

(*iii*) Here, the answers can be assessed with perfect objectivity and more validly and reliably, with the help of a marking scheme and a scoring key.

(*iv*) Answer books can be preserved for a long time, making measurement possible.

(*v*) Many students can be evaluated at a time, and at various places.

(*vi*) It helps teachers to plan and guide an instructional programme.

(*vii*) Question papers and answer books can be moderated.

Disadvantages

(*i*) Certain objectives, such as skill in handling apparatus, etc., cannot be evaluated.

(*ii*) Understanding/cramming may not be judged.

(*iii*) Its preparation takes a long time, so it cannot be taken as a *continuous part* of evaluation.

(*iv*) Written tests require a considerable amount of expenditure.

13.6 The Essay Test

The essay test refers to any written test that requires an examinee to write a sentence, a paragraph or longer passages and that demands a subjective judgement about its quality and completeness when it is scored.

For example, when asked to write a sentence using a verb, say, *tell*, it becomes an essay test. An M.Ed. dissertation and a Ph.D. thesis are also examples of an essay test.

Characteristics

(*i*) Most familiar and widely used.

(*ii*) The length of the required response may vary from one sentence to a lengthy composition requiring a day or more to complete in a comprehensive examination for some type of professional certification (M.Ed. dissertation, Ph.D. thesis).

(*iii*) Demands a subjective judgement.

13.7 The Essay Question

The distinctive features of the essay question are—

(*i*) no single answer can be considered throughout and correct ;

(*ii*) the examinee is permitted freedom of response ;

(*iii*) the answers vary in their degree of quality or correctness.

Classification of the Essay Question

Essay questions are sub-divided into two major types :

(*i*) Extended Response and (*ii*) Restricted Response, depending on the amount of latitude or freedom given to a student to organise his ideas and write his answer.

Extended Response

No restriction is placed on the student as to the points he will discuss and the type of organisation he will use. He may select those points that he thinks are most important, pertinent and relevant to his argument and he may organise the material in whichever way he wishes *e.g.*,

> "Describe at length the defects of the present-day examination system in the State of Maharashtra. Suggest ways and means of improving the examination system."

Extended response type of essay question permits a student to demonstrate his ability to—

(*a*) recall factual knowledge ;

(*b*) evaluate his factual knowledge ;

(*c*) organise his ideas ;

(*b*) present his ideas in a logical, coherent fashion.

It is at the levels of synthesis and evaluation of writing skills (style, quality) that this type of question makes the greatest contribution.

Restricted Response

Here the student is more limited in the form and scope of his answer, because he is told specifically the context in which his answer is to be made.

For example :

> "Explain, in not more than 100 words, the chemical changes that take place in our day-to-day life."

This type of question is of the greatest value for measuring learning outcomes at the comprehension, application and analysis levels.

Another Way of Classification

One can make a further or more elaborate classification of essay questions on the basis of the types of mental activities required of a pupil. Weidemann (1933, p. 82) classified the essay question into eleven major categories. Arranged from the simple to higher mental processes, these categories are :

(*a*) What, who, when, which and where ; (*b*) list ; (*c*) outline ; (*d*) describe ; (*e*) contrast ; (*f*) compare ; (*g*) explain ; (*h*) discuss ; (*i*) develop ; (*j*) summarise ; (*k*) evaluate.

13.8 Advantages of the Essay Test

(*i*) It is relatively easier to prepare and administer a six-question extended-response essay test than to prepare and administer a comparable 60-item multiple-choice test items.

(*ii*) It is the only means that can assess an examinee's ability to organise and present his ideas in a logical and coherent fashion and in effective prose.

(*iii*) It can be successfully employed for practically all the school subjects.

(*iv*) Some of the objectives—such as ability to organise idea effectively, ability to criticise or justify a statement, ability to interpret, etc.—can be best measured by this type of test.

(*v*) Logical thinking and critical reasoning, systematic presentation, etc. can be best developed by this type of test.

(*vi*) It helps induce good study habits such as making outlines and summaries, organising the arguments for and against, etc.

(*vii*) The students can show their initiative, the originality of their thought and the fertility of their imagination as they are permitted freedom of response.

(*viii*) The responses of the students need not be completely right or completely wrong. All degrees of comprehensiveness and accuracy are possible.

(*ix*) It largely eliminates guessing.

13.9 Disadvantages of the Essay Test

(*a*) Poor (limited) content sampling, especially in the extended-response type, is one of the most serious limitations of essay tests. You cannot sample the course content so well with six lengthy essay questions as you can with 60 multiple-choice test items.

(*b*) The essay test possesses relatively low validity and reliability because of the factors mentioned below :

- (*i*) Limited content sampling ;
- (*ii*) Subjectivity of scoring ;
- (*iii*) Contaminated by extraneous factors like spelling, good handwriting, coloured ink, neatness, grammar, length of the answer ;
- (*iv*) Halo effect—biassed judgement by previous impressions ;
- (*v*) Good verbal ability even in the absence of relevant points ;
- (*vi*) Mood of the examiner ;
- (*vii*) First impression ;
- (*viii*) Improper comparison of answers of different students—bright and dull ;
- (*ix*) Ambiguous wording of the questions. They may be interpreted differently by various students. This results in guessing and bluffing on the part of students.

(*c*) It requires an excessive time on the part of students to write ; while assessing, reading essays is very time-consuming and laborious.

(*d*) It can be assessed only by a teacher or competent professionals.

Thus, the potential disadvantages of essay tests are (*i*) poor predictive validity, (*ii*) limited content sampling, (*iii*) scores unreliability, and (*iv*) scoring costs.

13.10. Why are Essay Tests Still Popular ?

As Coffman (1971) has pointed out : "Essay examinations are still widely used in spite of more than a half century of criticism by specialists in educational measurement and evaluation." Given the potential disadvantages of essay tests, why are they still in use ? Why are essay tests so popular ?

(*a*) Acceptable claims (supporting evidence) :

- —Essay tests can indirectly measure attitudes, values and opinions.
- —Good essay tests are more *easily* prepared than good objective tests.
- —Essay tests are good learning experiences.

(*b*) Acceptable claims (*no* supporting evidence) :

- —If achievement is measured only by the selection type of objective tests, there may be deleterious effects in so far as teaching methods are concerned.
- —Essay tests require students to express themselves logically, coherently and in good language.

13.11 Improving Essay Tests

(A) While Framing Questions

(*a*) Give adequate time and thought to the preparation of essay questions, so that they can be re-examined, revised and edited before they are used. This would increase the validity of the test.

(*b*) The question should be so written that it will elicit the type of behaviour the teacher wants to measure. If one is interested in measuring understanding, he should not ask a question that will elicit an opinion ; *e.g.*,

> "What do you think of Buddhism in comparison to Jainism ?"

Framed this way, the question will elicit the students' *opinion* of, rather than their understanding of, the two *isms*.

(*c*) A well constructed essay question should establish a framework within which students operate ; *e.g.*,

(*i*) Delimit the area covered by the question ;

(*ii*) Use words which themselves give directions *e.g.*, define, illustrate, outline, select, classify, summarise, etc., instead of discuss, comment, explain, etc. ;

(*iii*) Give specific directions to students to elicit the desired response.

For example, "Discuss the analytical method of teaching Mathematics, giving its characteristics, merits, demerits and practicability. Give illustrations."

(*iv*) Indicate clearly the value of the question and the time suggested for answering it.

(*d*) Do not provide optional questions in an essay test because—

(*i*) It is difficult to construct questions of equal difficulty ;

(*ii*) Students do not have the ability to select those questions which they will answer best ;

(*iii*) A good student may be penalised because he is challenged by the more difficult and complex questions.

(*e*) Use a relatively large number of questions requiring short answers rather than just a few questions involving long answers because—

(*i*) Restricted-response essay questions would provide for a broader sampling of content ;

(*ii*) They tend to discourage bias on the part of the teacher who grades for quantity rather than quality ;

(*iii*) The teacher will be able to read the answer more rapidly and more reliably since he has a mental picture of what he should be looking for ;

(*iv*) It is easier to elicit the desired response from the students.

(*f*) Do not start essay questions with such words as *list*, *who*, *what*, *whether*. If we begin the questions with such words, they are likely to be short-answer questions and not essay questions, as we have defined the term.

(*g*) Adapt the length of the response and the complexity of the question and answer to the maturity level of the student.

(*h*) Use the novel type of question wherever feasible. The application of a principle or thought process to a new situation requires a higher level of learning. Too many teachers think that they are measuring understanding and application when, in reality, they are only measuring factual knowledge.

(*i*) The wording of the question should be clear and unambiguous. Explicitly state and qualify the problem so that it will be interpreted in the same manner by all students.

(*j*) Make certain that the achievement that you wish to evaluate cannot be measured with equal validity and reliability through the use of an objective type test.

(*k*) Allow a liberal time limit so that the essay test does not become a test of speed in writing. It should be a power test rather than a speed test.

(*l*) Supply the necessary training to the students in writing essay questions.

(B) While Scoring Questions

(*a*) Prepare a marking scheme, suggesting the best possible answer and the weightage given to the various points of this *model* answer. Decide in advance which factors will be considered in evaluating an essay response.

(*b*) While assessing the essay response, one must—

- (*i*) use appropriate methods to minimise bias ;
- (*ii*) pay attention only to the significant and relevant aspects of the answer ;
- (*iii*) be careful not to let personal idiosyncracies affect assessment ;
- (*iv*) apply a uniform standard to all the papers.

(*c*) Check your marking scheme against actual responses.

(*d*) Once the assessment has begun, the standard should not be changed, nor should it vary from paper to paper or reader to reader. Be consistent in your assessment.

(*e*) Grade only one question at a time for all papers. This will help you in minimising the halo effect in becoming thoroughly familiar with just one set of scoring criteria and in concentrating completely on them.

(*f*) Grade the response anonymously. This is to remove bias and halo effect.

(*g*) The mechanics of expression (legibility, spelling, punctuation, grammar) should be judged separately from what the student writes, *i.e.*, the subject matter content.

(*h*) Try to score all responses to a particular question without interruption. This will increase reliability.

(*i*) If possible, have two independent readings of the test and use the average as the final score.

(*j*) Provide comments and correct answers in the answer book. This will explain the teacher's method of assigning a particular score (or grade) to a particular paper.

(*k*) Set realistic standards.

(*l*) The paper-setter should assess the answer books.

13.12 The Oral Test

The oral approach, rather than the oral exam, is frequently used by the classroom teacher. Every day, pupils are asked questions by their teachers. Although the results of the answers to these questions may not be (although they may be and sometimes are) used by the teacher, both teachers and pupils can, if they wish, profitably use the results so obtained to improve the teaching-learning situation.

The Oral Question

The oral question is a variation of the essay question. Oral questioning provides immediate feedback to both pupil and teacher.

Merits of an Oral Test

(*i*) It helps a teacher to know whether a student *knows* ;

(*ii*) It helps a teacher to make evaluation continuous ;

(*iii*) Some objectives like oral expression, pronunciation, recitation, etc., are evaluated by this type of test only ;

(*iv*) It permits the examiner to determine how well a pupil can synthesise, integrate and organise his ideas and express himself.

(*v*) It permits free response by students ;

(*vi*) It is best for young children who have not mastered the skills of reading and writing ;

(*vii*) The relative informality of the oral test is far less frightening to a timid child ;

(*viii*) It permits a detailed probing by an examiner and hence may be very useful in the diagnostic sense. A very well qualified examiner can actually elicit responses that may be indicative of a student's thinking process ;

(*ix*) The pupil can ask for clarification ; he can ask to have the question rephrased ;

(*x*) The examiner is able to calm a student by either rephrasing a question or by reassuring him ;

(*xi*) It is valuable for testing physically handicapped students who are unable to take written tests ;

(*xii*) It is valuable in those situations where the objective is to see how a pupil will conduct himself before a group of people (*e.g.*, a course in public speaking) ;

(*xiii*) It saves a lot of the expense involved in written tests.

Limitations of an Oral Test

(*i*) It provides for a very limited sampling of the content of a course ;

(*ii*) It has low reliability because of inadequate sampling. The teacher is forced to evaluate each student on the basis of a very limited sample of responses ;

(*iii*) It is very subjective : (*a*) it is affected by minor changes in the psychological and physical states of the teacher or the student ; (*b*) it is influenced by what the examiner knows about the examinee and so may not be equally fair to all pupils ; (*c*) it permits favouritism by the teacher.

(*iv*) It cannot have a permanent objective record of a student's responses for future reference (unless tape recorders are used) ; and item analysis is difficult to obtain ;

(*v*) The results cannot be accumulated for reference to any other person than the examiner himself (unless tape recorders are used) ;

(*vi*) It is very costly and time-consuming, for only one student can be tested at a time ;

(*vii*) It often encourages lack of planning ;

(*viii*) The questions put to different students may have a different difficult value ; comparability of questions is difficult to obtain ;

(*ix*) It does not provide a complete picture of the abilities of a student ;

(*x*) It does not test a student extensively or efficiently.

Suggestions for Improving an Oral Test

(*i*) Decide first the objectives and the content area ;

(*ii*) Only those objectives, which cannot be evaluated by a written test should be evaluated by an oral test ;

(*iii*) Plan for the questions to be used and also for acceptable answers ;

(*iv*) Decide on the method of grading beforehand ;

(*v*) Questions of almost equal difficulty value should be asked.

Evaluate Yourself

1. Explain the importance of teacher-made tests.
2. What are the deficiencies of teacher-made tests ?
3. What are the defects of the present-day examination system ? Give your suggestions for improving them.
4. Classify the teacher-made tests in a variety of ways.

5. What is a written test ? Mention its advantages and disadvantages.
6. What do we mean by an essay type test ? Mention its characteristics.
7. How will you classify essay type questions ? Explain with examples.
8. What are the advantages and disadvantages of an essay test ? Suggest ways and means of improving it.
9. Why are essay tests still popular ?
10. What are the merits and limitations of an oral test ? Give suggestions for their improvement.
11. Explain, with illustrations, the factors that make the essay test less reliable and less valid.
12. Why should optional questions not be provided in an essay test ?
13. What points should be borne in mind while assessing an essay test response ?
14. Why is oral test considered very subjective ?
15. Write short notes on :
    (*a*) Teacher-made tests ;
    (*b*) Present-day examination system ;
    (*c*) The essay test ;
    (*d*) The oral test.
16. The present system of examination is very subjective and its result is seldom valid and reliable. What steps would you suggest to make it more objective and reliable ?
17. Distinguish between objective type questions and objective based questions ?
18. What is the difference between formative and summative type of evaluation ?
19. Mention any *four* objectives that can be evaluated through oral examination.
20. Write any three uses of Sociogram.

14

The Classroom Testing

TEACHER-MADE TESTS II (OBJECTIVE TYPE)

14.1. Objective Type Test

Definition : It refers to any written test that requires the examinee to select the correct answer from among one or more of several alternatives or supply a word or two and that demands an objective judgement when it is scored.

Objective-centred Test : When questions are framed with reference to the objectives of instruction, the test becomes objective-centred or objective-based. This type of test may contain essay type and objective type test items. An essay test may be objective-centred or objective-based, though it may be difficult to score it objectively. An objective type test, on the other hand, can always be scored objectively, though it may not be objective-centred if it is not planned with reference to the objectives of instruction.

Objective Type Test Item : The most important criterion of an objective type test item is that it can be most objectively scored. The scoring will not vary from examiner to examiner.

Classification of Objective Type Test Item

All objective type test items may be sub-divided into three classes :

(*a*) Supply type or recall type (short-answer, completion) ;

(*b*) Selection type or recognition type (alternate response, matching, multiple-choice) ;

(*c*) Context-dependent type (pictorial form, interpretative).

Merits of Objective Type Test

(*i*) It can be scored objectively and easily. The scoring will not vary from time to time or from examiner to examiner.

(*ii*) In this test, a more extensive and representative sampling can be obtained. This reduces (*a*) the role of luck and (*b*) cramming of expected questions. As a result, there is greater reliability and better content validity.

(*iii*) It possesses economy of time, for it takes less time to answer than an essay test. Comparatively, many test items can be presented to students. It also saves a lot of time of the scorer.

(*iv*) It eliminates extraneous (irrelevant) factors such as speed of writing, fluency of expression, literary style, good handwriting, neatness, etc.

(*v*) It creates an incentive for pupils to build up a broad base of knowledge, skills and abilities.

(*vi*) It measures the higher mental processes of understanding, application, analysis, prediction and interpretation.

Limitations of Objective Type Test

(*i*) Objectives like ability to organise matter, ability to present matter logically and in a coherent fashion, etc., cannot be evaluated.

(*ii*) Guessing is possible. No doubt, the chances of success may be reduced by the inclusion of a large number of items.

(*iii*) The construction of adequate objective type test items is difficult. It requires special abilities and is time-consuming.

(*iv*) Printing cost is considerably greater than that of an essay type test.

Guidelines For Constructing Better Objective Type Test Items

To be a good item writer, one should have—

(*a*) a thorough understanding of the subject matter ;

(*b*) a thorough understanding of the pupils tested ;

(*c*) perseverance ; and

(*d*) a little creativity to prepare fertile (and not sterile) kind of items.

Again, it is of paramount importance for him to be cognizant of the pitfalls involved in writing objective type test items. We shall now offer some general guidelines for the writing of objective type test items :

(*i*) Test for important facts and knowledge and not for trivial details ; *e.g.* :

(*a*) Give the name of the ship that Columbus was on when he discovered America.

(*b*) Give the date (and/or time) when Edison invented the light bulb.

These items test the ability to recall or supply trivial details and therefore are unsound.

(*ii*) Tailor the items to fit the examinee's age and ability level as well as the purpose of the test. Keep this in mind with reference to (*a*) their vocabulary, (*b*) the type of objective item format, and (*c*) content and objectives.

(*iii*) Write the item as clearly as possible. Lack of clarity may arise from (*a*) an inappropriate choice of the words used, (*b*) an awkward arrangement of words, or (*c*) excessive verbiage ; *e.g.*,

Poor : T F The time required for one oscillation of the pendulum depends upon the distance between the support of the pendulum and the centre of gravity of the bob.

Better : T F The period of the pendulum depends upon its length.

(*iv*) Avoid ambiguous statements. Each item should be subjected to one and only one interpretation.

Poor : Rabindranath Tagore wrote *Gitanjali* in——.
The item is ambiguous because the examinee does not know whether the teacher wants to know the year, the date, the language or the place.

Better : In which language did Rabindranath Tagore write *Gitanjali* ?

(*v*) Quantitative rather than qualitative words should be used. Words such as *few*, *many*, *low*, *high*, *large*, etc., are vague, indefinite, and, therefore, should be avoided.

Poor : T F Many people are literate in Kerala.

Better : T F About 85% of the people are literate in Kerala.

(*vi*) Use good grammar and sentence structure to improve clarity.

Poor : T F In a triangle, whose one of the angle's measure is 90, the hypotenuse is equal to the square root of the sum of the squares of the other two sides.

Better : T F In a right-angled triangle, the square on the hypotenuse is equal to the sum of the squares on the other two sides.

(*vii*) Use simple numbers and have the answer come out as a whole number if the purpose of a test item is to measure the understanding of a principle rather than computational skill.

Poor : What is the compound interest on Rs. 529.89 at the rate of $8\frac{3}{4}$ per cent for 2 years and 8 months ?

Better : What is the compound interest on Rs. 500 at the rate of 8 per cent for 3 years ?

(*viii*) Avoid lifting statements verbatim from the text book. The use of text book language in a test encourages a pupil to memorise rather than to understand the subject matter.

Poor : If a set contains no *members*, it is called a—set.

Better : Which of the following is null set :

(A) $\{ o \}$;

(B) A set of natural numbers between 3 and 4 ;

(C) A set of rational numbers between 3 and 4 ;

(D) A set of prime numbers between 30 and 40 ?

(*ix*) Avoid using inter-related (inter-dependent) items. They are grossly unfair, since they may penalise students who do not know the answer to the previous item ; *e.g.*,

(*a*) Which of the following is the formula for finding the number of subsets of a given set ? (n being the number of members of a given set).

A. $2n$ B. $2+n$ C. n^2 D. 2^n

(*b*) The number of subsets of the set $\{ 1, 2, 3 \}$ is——

A. 3 B. 6 C. 8 D. 9.

Here, if a student does not know the correct answer to the first item, he will be penalised in the second item.

(*x*) There should be only one correct answer.

Poor : Fill in the blank by inserting an operational symbol :

$2 — 2 = 4$

Here, some students may write +, others may write ×.

(*xi*) The authority should be mentioned for statements that may be considered controversial.

Poor : T F The concept is an idea.

Better : T F According to Layman, the concept is an idea.

(*xii*) Avoid negative questions whenever possible. An indiscriminate use of the negative should be avoided. Since the pupil has to change his normal thought processes, he may overlook the negative aspect and answer the item incorrectly even though he knows the correct answer. Again, it takes more time to answer.

Poor : T F The longitude of Bombay is not 73°E.

Better : T F The longitude of Bombay is 73°E.

(*xiii*) Do not give the answer away. Students should not get the correct answer because of some irrelevant clue(s) ; *e.g.*,

(*a*) information in the stem of one item may provide the answer to another item ;

(*b*) lack of parallelism between stem and responses in the multiple-choice item (MC item) ;

(*c*) the length of the correct response in MC items ;

(*d*) the position and pattern of the correct answer in MC items (a random pattern should be followed) ;

(*e*) grammatical clues such as a/an preceding a blank in the short-answer or at the end of the stem in the MC items ;

(*f*) verbatim use of text book language ; *e.g.*,

Item 25 : The latitude and longitude of Delhi, the capital of India, are......

(A) 23°S, 80°W ;
(B) 23°N, 80°E ;
(C) 80°S, 23°W ;
(D) 80°N, 23°E.

Item 42 : The name of the capital city of India is......

(A) Bombay, (B) Calcutta,
(C) Madras, (D) Delhi.

The student obtains the correct answer to item 42 because the answer is in the stem of item 25.

Item 50 : Kishan is an *intelligent* boy. The word intelligent is an...

(A) Verb, (B) Preposition,
(C) Adjective (D) Noun.

Here, the article *an* in the stem suggests the correct answer.

If the correct answer follows a pattern in true-false tests such as T, F, T, F, T, F, or in multiple-choice tests A, D, C, B, A, D, C, B, the pupil is likely to discover the arrangement. Hence, to minimise pattern-clues (*a*) random assignment of correct answer, (*b*) approximately an equal number of true-false statements, and (*c*) approximately an equal number of correct answers for each response position in the MC item should be employed.

(*xiv*) Avoid tricky and catch items, otherwise the rapid reader is likely to be penalised. If the test is designed to measure accuracy of proof reading, such test items are justified.

Poor : T F The Magna Carta was signed in 1215 B.C.

Better : T F A circle with a radius of 3 cm has a diameter of 6 mm.

Substitution of B. C. for A. D. or mm for cm may be treated as typographical errors by some pupils.

(*xv*) Avoid an unnecessary use of difficult words or symbols ; otherwise the test becomes a verbal ability test.

Poor : List the members of the set, $A=\{X : 5<X<10 ; X \in N\}$.

Better : List the members of the set A consisting of natural numbers between 5 and 10.

Students from a lower class would be handicapped because of the use of symbols in the first statement.

(*xvi*) Get an independent review of your test item from a teacher who teaches the same subject. Such a review will permit an item-writer to obtain another opinion about—

(*a*) the difficulty of the items ;

(*b*) the adequacy of content sampling ;

(*c*) the plausibility of the distractors (in an MC item) ;

(*d*) the adequacy of the scoring key ;

(*e*) the technical quality of the items.

14.2 Short-Answer and Completion Items

A short-answer item is classified as a supply type (recall type) objective item. The three common varieties of the short-answer form are :

(*a*) **The Question Variety**

Here, the item is presented as a direct question ; *e.g.*,

Who succeeded Akbar ?

(*b*) **The Completion Variety**

Here, an incomplete statement is used ; *e.g.*,

Bombay is the capital of the State of—

(*c*) **The Association Variety**

After each city, write the name of the State in which the city is located :

Poona ( ) ;
Surat ( ) ;
Bhopal ( ).

In each form, the pupil answers with a word, phrase, mathematical symbol, chemical formula, etc. This type of item is something of a compromise between an essay item and other types of objective items. Like essay items, they require recall rather than recognition.

Advantages of a Short-Answer Item

(*i*) A relatively large sample of the content can be covered ;

(*ii*) easy to construct, maybe because it measures a relatively sample learning outcomes ;

(*iii*) it provides little opportunity for guessing as the student is required to supply information or to solve a numerical problem ;

(*iv*) useful in evaluating the ability to interpret diagrams, charts and graphs ;

(*v*) useful in evaluating spelling and knowledge of a foreign language ;

(*vi*) useful in Mathematics and Science where a computational answer is required or where a formula or equation is to be written ;

(*vii*) objectives of understanding, application and problem-solving skills can be measured with a short-answer item ; *e.g.*,

(*a*) A soldering iron takes 1.1 amperes when used on a 110 volt circuit. Its resistance is——ohms.

(*b*) The sum of twice a number and 7 is 39. What is the number ?

(*c*) Solve : $X+3=12 \quad \therefore \; X=$——.

(*d*) What is the chemical formula of sulphuric acid ?

Limitations of Short-Answer Item

(*i*) Less objective than the other types of objective items ;

(*ii*) It is limited to questions that can be answered with a word, phrase, symbol or number. There are very few instances when an abstraction, generalisation, or interpretation can be adequately presented by the examinee in one or two words ;

(*iii*) It is almost impossible to write good short-answer items that require a student to exhibit synthesis and interpretation so that one and only one answer will be correct.

(*iv*) Its excessive use may encourage a student to memorise and develop poor study habits, because short-answer items are best for measuring highly specific facts like dates, names, places, vocabulary ;

(*v*) Scoring can be quite tedious and somewhat subjective. It may not be quick, easy, routine and accurate because of the variety of acceptable answers and also because of the multiplicity of plausible answers which can seldom be anticipated. Hence, it lowers test validity and test reliability ;

(*vi*) Clerks cannot be used as scores, for they cannot often decide whether a given answer is right, wrong or partially right.

Suggestions for Constructing Short-Answer Items

(*i*) For computational problems, the teacher should specify the degree of precision and the units of expression expected in the answer ;

Poor : The value of π is——(3.1, 3.14, 3.142).

Better : The value of π (to 3 decimals) is——.

Poor : What is the area of a rectangle whose length is 6 m and breadth 75 cm ?

Better : What is the area of a rectangle whose length is 6 m and breadth 75 cm ? Express your answer in sq. m.

(*ii*) Avoid lifting statements directly from the text, for these place much emphasis on memory and parrot-like learning.

Poor : Heat expands, cold——.

Better : What changes in volume will you notice if the temperature of a metal cube is lowered from 800°C to 100°C ? (It contracts.)

(*iii*) Omit important words only. Only key words should be omitted. The student should be asked to supply an important fact. If verbs, pronouns or adverbs are omitted, a variety of plausible answers will be received, but the item may no longer possess content validity.

Poor : Columbus-----America in 1492.

Here, answers such as *discovered*, *left*, *sailed to*, *come to* would all have to be considered correct.

(*iv*) There should be only one correct answer.

Poor : 15 is a——number (natural, whole, rational, real).

Poor : World War II ended in——(Japan, 1945, victory).

(*v*) The response should be very definite. The words of a problem should be so framed that the response will be a word or two or a number.

Poor ; What is density ?

Better : Mass per unit volume is called——(density).

(*vi*) Avoid excessive blanks in a single item. What is explicit to the tester must also be made explicit to the examinee. If too many key words are omitted, an achievement test may turn into an intelligence test or a guessing game. Overmutilation can only result in the item's being ambiguous and confusing.

Poor : The——is the ratio of the——to the——.

Better : The sine is the ratio of the——to the--—— (opposite side, hypotenuse).

(*vii*) Have the blanks occur near the end of a sentence. When a blank is at the beginning or in the middle of a sentence, the essential point of the question may be overlooked or forgotten by the time a young child reads the item.

Poor : The——is the law-making body of the University.

Better : The law-making body of the University is the—— (Senate).

(*viii*) Make the blanks of uniform length, to avoid giving an irrelevant clue to the correct answer. Blanks should almost always call for one word, number, formula or symbol. Provide two blanks if there are two consecutive missing words.

Poor : An *ohm* is the ratio of—(volt) to the——(ampere).

Better : An *ohm* is the ratio of——to the——.

Blanks can be numbered and the pupil instructed to write the answer in the corresponding numbered blank at the side of the page.

Example : Density is the ratio of **(1)** to **(2)**.

Answers
(1)——
(2)——

In this case, the scoring will be more rapid.

(*ix*) Avoid giving irrelevant clues (grammatical or length of blank).

Poor : { 1, 2, 3,... } is an——set (infinite).

Better : { 1, 2, 3,... } is a(n)——set.

Poor : A singleton set has only——member.

Better : A singleton set has only——member(s).

(*x*) Generally speaking, it is advantageous to use a direct question rather than an incomplete statement because—

(*a*) it may be easier to phrase the question so that it is less ambiguous and does not provide irrelevant clues ;

(*b*) it is more natural to pupils who are used to answering a teacher's questions in the class ;

(*c*) there is less likelihood that the question can be copied verbatim from a printed text ;

(*d*) the blank will be at the end of the item ;

(*e*) the question form tends to be more specific.

Poor : The capital of India is——.

Better : What is the name of the capital city of India ?

(*xi*) To test the knowledge of a definition and/or the comprehension of technical terms, use a direct question in which the term is given and a definition is asked for.

Poor : What is the scientific term that describes the rate of change of velocity ? (Acceleration.)

Better : What is acceleration ?

14.3 The Alternate-Response items

An alternate-response item is essentially a two-response multiple-choice item in which only one of the answers is presented and the student judges the truth or falsity of the statement.

Some of the more common variations of alternate-response items are (*a*) true-false ; (*b*) yes-no ; (*c*) right-wrong ; (*d*) cluster variety ; and (*e*) correction variety.

True-False Variety

The student is presented with a declarative statement that is true or false.

T F An equilateral triangle has two sides congruent.

Yes-No Variety

This variety consists of a direct question or declarative statement that is to be answered with a "yes" or a "no"

Y N Is -25 greater than -18 ?

This form is also useful in measuring attitudes, beliefs, opinions, values, and interests.

Y N I like to play outdoor games.
Y N The government should provide for the education.
Y N Colleges of Education should introduce *moral education*.

Right-Wrong Variety

Directions : The following are some pairs of words. If two words have opposite meanings, write an R in the blank and, if not, write W.

( ) like-dislike ;
( ) cover-discover.

Cluster Variety

In the cluster variety, there is one incomplete stem (statement) with several suggested answers to be judged as true or false.

A parallelogram has—

T F (*a*) opposite sides congruent ;
T F (*b*) all the angles congruent ;
T F (*c*) diagonals that bisect each other at right angles.

It permits the item-writer to ask many questions using a single stem and thereby conserving space and reading time.

Correction Variety

Here, the student is required to make every false statement true by crossing out the incorrect portion which is usually underlined and replacing it with the correct word or phrase.

T F The square root of 49 is 9.

To make the statement true 9 is to be replaced by 7.

T F The square root of 49 is 9.

To make the statement true *49* is to be replaced by 81.

Advantages of True-False Items (T/F Items)

(*i*) They are good for young children who have poor reading habits.

(*ii*) They can cover a large portion of the subject matter in a relatively short space and short period of time.

(*iii*) They provide high reliability per unit of testing time.

(*iv*) They can be scored quickly, reliably and objectively.

(*v*) They are particularly suitable for testing beliefs in popular misconceptions and superstitions.

(*vi*) They are adaptable to most content areas.

(*vii*) They can be more easily constructed than other objective type items.

(*viii*) The directions are easily understood.

(*ix*) This type of item is a time-saver, for it allows for frequent testing.

(*x*) They can be conveniently used to measure (*a*) the ability to identify the correctness of statements, (*b*) the ability to distinguish fact from opinion, and (*c*) the ability to recognise the cause-and-effect relationship.

(*xi*) If carefully constructed, they can measure the higher mental processes of understanding, application and interpretation ; *e.g.*,

T F Oxygen turns lime water milky (factual knowledge).

T F Kinetic energy is found in a wound spring (comprehension or understanding).

T F The number of subsets of a set having three elements is 8 (application).

T F In a room of ceiling height 12 feet, a ladder of 15 feet length can be set (deductive skill).

T F $M=DV$. If $M=20$ and $V=4$, then $D=5$ (problem solving ability).

T F Water under pressure has a boiling point higher than 100°C at sea level (cause-effect relationship).

Limitations of T/F Items

(*i*) Pupils' scores on T/F tests can be unduly influenced by good or poor luck in guessing.

(*ii*) They are more susceptible to ambiguity and misinterpretation than any other selection-type objective item, and have therefore a low reliability.

(*iii*) They lend themselves most easily to cheating.

(*iv*) They tend to be less discriminating, item for item, than MC tests.

(*v*) Many times, the true-false statements are not unequivocally true or false ; rather, there are degrees of correctness. *Water boils at 100°C* would be true only at sea level.

Conclusion : Although constructing items to measure the higher mental processes can be both difficult and time-consuming, it is less difficult to construct a good T/F item than to construct a good five-response MC item.

Guidelines for Constructing T/F Items

(*i*) Use simple, clear language to avoid ambiguity. Avoid loose quantitative terms like *more*, *few*, *heavier*, *lighter*, etc.

Poor : T F The Congress received a large number of votes in the 1971 election.

Better : T F The Congress received more than 55% of the votes in the 1971 election.

(*ii*) Partly true (or false) statements should not be used.

Poor : T F $12>10$, since 12 is on the left of 10 on the number line.

(*iii*) When a true-false item is used to test cause-and-effect telationships, the first proposition in the statement should always be rrue, with the subordinate clause (reason or explanation) being written as either false or true.

Poor : T F An immovable pulley gives mechanical advantage (false) because in it, the *fulcrum* is between *effort* and *load* (true).

Better : T F An immovable pulley gives no mechanical advantage (true) because in it the power arm is greater than the load arm (false).

(*iv*) Avoid tricky statements.

Poor : T F The title *Iron man of India* was given to Sardar Patil.

The trick here is that the Sardar's surname is spelled as Patil instead of Patel.

(*v*) Avoid specific determiners. In the T/F test the sentences containing qualifiers, such as *usually*, *some*, *generally*, *should*, *sometimes*, *may*, are more often true than false, while strongly-worded statements containing the qualifiers such as *always*, *never*, *none*, *all*, *entirely*, etc., are found more often false than true. Pupils learn very quickly that the odds are in their favour to mark test items as true or false, depending upon the qualifiers used. In the long run, they will be more often right than wrong.

(*vi*) Avoid lifting statements verbatim from the the text. This is to discourage students from cramming or memorising.

(*vii*) Avoid making true statements consistently longer than false ones (usually long statements are like to be true). The item-writer should vary the length of both true and false statements.

(*viii*) For the correction type of T/F item, underline the word(s) to be corrected.

(*ix*) Have approximately (not exactly) an equal number of true and false statements. This is to avoid giving clues. Ebel (1965, p. 146) suggested having more false than true statements since there is evidence that false statements tend to be more discriminating.

(*x*) A random occurrence of true and false statements should be employed to avoid giving irrelevant clues.

(*xi*) The authority must be mentioned for statements that may be considered controversial.

Poor : T F Abstract thinking is intelligence.
Better : T F According to Garett abstract thinking intelligence.

(*xii*) Correction for guessing should be used in scoring the test. The standard correction-for guessing formula is :

$$\text{Score} = R - \frac{W}{n-1}$$ where R=number right

W=number wrong.
n=number of options.

(*xiii*) Double negative statements should be avoided. They may confuse students.

Poor : T F No three points are collinear if they do not lie on the same line.

Better : T F Three points are collinear if they lie on the same line.

(*xiv*) Use the simplest possible method of indicating the response. You may ask students to write T for true, F for false or + for true and O for false statements.

14.4 The Matching Tests

In the traditional format, the matching test consists of two columns—one (the left one) consisting of the questions or problems to be answered (premises), and the other (the right one) of answers (responses). The examinee is required to make some sort of association between each premise response. He pairs the corresponding elements and records his answers.

Directions : In the blank to the left of each instrument given in column (A), write letter of the laws given in column (B) upon which the instrument works. You may use a letter in column (B) once, more than once or not at all.

Column A	Column B
( ) (*i*) Spring balance	(*a*) Law of moments.
( ) (*ii*) Physical balance	(*b*) Hook's Law
( ) (*iii*) Lactometer	(*c*) Law of floatation
( ) (*iv*) Hydrometer	(*d*) Pascle's Law
( ) (*v*) Nut-cracker	

Modifications of Matching Tests

There are many modifications of the matching test *e.g.* students may be given a map or diagram on which certain locations or parts are assigned letters or numbers. These letters or numbers are then to be matched with the names of the cities, lakes, rivers, or organs, or other entities.

Another variation of the matching test is what is known as the Master Matching Test, consisting of a set of alternatives which serve as a master list and a number of statements or questions following it, each to serve as a stem. An example is presented below :

Directions : Determine whether each of the sentences through (*i*) to (*x*) given below is simple, compound, complex, or compound-complex. Using the key below, write the letter of the type of sentence it is in the blank to the left of the sentence.

Key : (*a*) Simple sentence ;
(*b*) Compound sentence ;
(*c*) Complex sentence ;
(*d*) Compound-complex sentence.

Sentences

( ) (*i*) Time is made up of a succession of tomorrows.
( ) (*ii*) Woman is fickle.
( ) (*iii*) It is better to be Mr. Late than to be the late Mr.
( ) (*iv*) Youth is a flower of which love is the fruit.
( ) (*v*) What little I know teaches me to trust the creator for what I do not know.
( ) (*vi*) It is easier for a man to die for a woman he loves than to live with her.
( ) (*vii*) Neither a borrower nor a lender be.
( ) (*viii*) Sweet are the memories silently kept, of the one we loved so deeply, and can never forget.
( ) (*ix*) Love thy neighbour as thyself.
( ) (*x*) I came, I saw, I conquered.

This pattern is an economical way of putting a number of MC items. It presents an efficient means of exploring the range of mastery of a concept. This pattern is well suited to topics dealing with criticism, explanation, understanding and simple relationships.

Uses of Matching Tests

(*i*) The matching tests should be used only when the teacher is constructing MC items and discovers that there are several such items having the same alternatives.

(*ii*) They should be used if the teacher is interested in testing the knowledge of terms, definitions, dates, events and other matters, involving simple relationships. Dates may be matched with events, authors with titles of books, tools with their uses, etc.

(*iii*) They can be used to determine whether a pupil can discriminate among nouns, verbs, adjectives, adverbs, etc.

Advantages of Matching Tests

(*i*) Because they require relatively little reading time, many questions can be asked in a limited period of testing time.

(*ii*) They afford us an opportunity to have a large sampling of the content, which ultimately increases the reliability of the test.

(*iii*) Like T/F or MC items, matching tests are amenable to machine scoring. Even with hand-scoring, they can be scored more easily than the essay or short-answer test.

(*iv*) The matching tests can be constructed relatively easily and quickly.

(*v*) A great deal of space can be saved and the pupil usually has less reading to do.

(*vi*) They give less opportunity for guessing than T/F tests or MC tests, because all the responses are plausible distractors for each premise.

Limitations of Matching Tests

(*i*) If sufficient care is not taken in their preparation, they may encourage serial memorisation rather than association.

(*ii*) It is sometimes difficult to get clusters of questions that are sufficiently alike so that a common set of responses can be used.

(*iii*) Items are likely to include irrelevant clues to the correct answer.

(*iv*) They cannot be very successfully used for measuring understanding or the ability to discriminate because of the difficulty of finding homogeneous responses that are answers to a certain premise and that are, for other premises, distractors requiring careful thought before rejection.

Guidelines for Constructing Matching Tests

(*i*) If at all possible, have the response list consists of short phrases, single words or numbers. Putting the lengthier premises will make for easier reading by the pupil.

(*ii*) Each matching test should consist of homogeneous items. It should consist of items that deal with only a single concept, classification or area. This will increase validity.

Poor :

Column A	**Column B**
( ) (*i*) Invented radium	(*a*) Lal Bahadur Shastri
( ) (*ii*) Discovered America	(*b*) Bell
( ) (*iii*) First P.M. of India	(*c*) Vasco da Gama
( ) (*iv*) Invented Telephone.	(*d*) Marconi
	(*e*) Columbus
	(*f*) Madan Curie
	(*g*) Jawaharlal Nehru.

Here, column B consists of explorers, scientists and politicians. For higher class students, the list would be very heterogeneous.

(*iii*) Keep each list relatively short. Short lists are preferred because they save reading time, maintain homogeneity and increase validity.

(*iv*) Avoid having an equal number of premises and responses. Avoid a one-to-one match. A good rule-of-thumb to follow is to have two or three more responses than premises. The student may be asked to use any one response once, more than once, or not at all. This will minimise guessing.

(*v*) Arrange the answers in some systematic fashion ; *e.g.*, words in alphabetical order, numbers in ascending or descending order, dates and years in chronological order, etc. This will increase the effectiveness of the test.

(*vi*) Avoid giving extraneous or irrelevant clues.

(*vii*) Indicate clearly the basis on which the match is to be made. Except in one-to-one match, confusion can result when any single response may be used once, more than once or not at all.

(*viii*) Maintain grammatical consistency. Use all proper nouns or all common nouns, all singulars or all plurals, all men or all women. Do not have the name of one woman among ten men and ask for the name of the heroine of a novel.

(*ix*) Every response in one column should be a plausible answer to every premise in the other column.

(*x*) The premises should be identified by numbers (since each one is a test item) and the responses should be identified by letters.

(*xi*) All items should be on the same page with a view to saving time and avoiding confusion on the part of the examinee.

(*xii*) Avoid asking the student to match parts of incomplete sentences because of the probability of introducing grammatical clues to the correct responses.

Common Faults of Teacher-made Matching Tests

(*i*) The directions are vague.

(*ii*) The sets to be matched are excessively long.

(*iii*) The list of responses lacks homogeneity.

(*iv*) The material is not simple for the students to respond to.

(*v*) The premises are vaguely stated.

14.5 The Multiple Choice Item (The MC Item)

The MC item consists of two parts :

(*i*) *The stem*, which contains the problem ;

(*ii*) *Responses or options, i.e.*, a list of suggested answers.

The incorrect responses are often called *distractors*, the correct response, the *key*. The stem may be stated as a direct question or an incomplete statement. From the list of responses provided, the student selects the one that is correct or best.

Question Variety

Stem : Which of the following men invented the telephone ?

Responses or options :

(*a*) Marconi (*b*) Edison (*c*) Bell (*d*) Faraday (*e*) Morse.

Incomplete Variety

Stem : The telephone was invented by—

Responses : (*a*) Marconi (*b*) Edison (*c*) Bell (*d*) Faraday (*e*) Morse.

The direct question format has several advantages.

(*i*) It forces the item-writer to state the problem clearly in the stem.

(*ii*) It reduces the possibility of giving the examinee grammatical clues.

(*iii*) It may be more easily handled by the younger and less able students because less demand is made on good reading skills.

One disadvantage of the direct question format is th
may require lengthier responses.

Variations of the MC Format

Ordinarily, the following four variations exist :

1. One Correct Answer

This is the simplest type of MC item. The student is required to select the one correct answer listed among several plausible, but incorrect, options. For example,

What is 5.6 × 100 equal to ?

(*a*) 560 ; (*b*) 56.0 ; (*c*) .560 ; (*d*) .056 ; (*e*) 5.600.

2. Best Answer

Here, the student is told to select the best answer. For example,

The value of π can be accurately given by
(*a*) 3.00 ; (*b*) 22/7 ; (*c*) 3.1 ; (*d*) 3.142.

All the responses here are correct to a certain degree of correctness, but the best one is (*b*).

3. Analogy Type

In this format, the student is required to deduce the relationship that exists between the first two parts of the item and then apply it to the third and fourth parts. Normally the third part is given and the missing fourth part is selected from the list of options on the basis of the relationship existing between the first two parts. For example,

Vitamin A : Eye disease : : Vitamin C :——
(*a*) Beribery (*b*) Scurvy (*c*) Cretinism (*d*) Hybridism.

4. Reserve Type

It is sometimes called the negative variety of MC item. Here, all but one of the responses are correct. The student is asked to select the incorrect response. Its use, unless absolutely necessary, is not recommended.

Advantages of MC Items

(*i*) They can measure learning outcomes with respect to factual recall, ability to apply understanding, ability to interpret data, ability to reason, ability to exercise judgement, ability to justify methods, etc.

(*ii*) They can be scored entirely objectively, quickly and accurately by machines, clerks, and even students themselves.

(*iii*) They are relatively efficient. T/F and matching items are slightly more efficient in terms of the number of questions that can be asked in a prescribed time and the space needed to present the questions, while the essay questions are far less efficient.

(*iv*) The degree of difficulty of the test can be controlled by changing the degree of homogeneity of the responses.

(*v*) Compared to T/F items, MC items have a relatively small susceptibility to score variations due to guessing.

(*vi*) They provide valuable diagnostic information, especially if all the responses are plausible and vary only in their degree of correctness.

(*vii*) They usually provide greater test reliability per item than the T/F items do.

(*viii*) They are easier to respond to and are better liked by students than T/F items. Students feel they are less ambiguous than T/F items.

(*ix*) They are less vague than completion-type items.

(*x*) Guessing can be minimised by increasing the number of responses to four or five.

(*xi*) They can be conveniently used for numerous subject matter areas.

(*xii*) There is no need for finding a number of parallel relationships as is necessary in a matching test.

Limitations of MC Items

(*i*) They are very difficult to construct. Teachers cannot always think of plausible distractors. More skill and more time are required.

(*ii*) There is a tendency for teachers to write MC items demanding only factual recall.

(*iii*) They require more time for students to respond to.

(*iv*) They are not well-adapted for measuring the ability to organise and present ideas.

(*v*) They require more space per item.

Guidelines for constructing MC Items

(*i*) The essence of the problem should be in the stem, which should be meaningful in and of itself. The stem must consist of a statement that contains a verb, and should be a good short-answer item.

Poor stems : The period of the pendulum...
25...

The coefficient of...

Better stems : Which of the following affects the period of the pendulum ?

25 is the square root of...

(*ii*) Avoid repetition of words in the options. This will save reading time and conserve space.

Poor : The period of the pendulum

(*a*) depends upon the size of the bob ;
(*b*) depends upon the length of the pendulum ;
(*c*) depends upon the span of oscillation ;
(*d*) depends upon the weight of the bob.

Better : Which of the following affects the period of the pendulum ?

(*a*) Size of the bob ;
(*b*) Length of the pendulum ;
(*c*) Span of oscillation ;
(*d*) Weight of the bob.

Poor : 25
(*a*) is the square root of 5 ;
(*b*) is the square root of 2×5 ;
(*c*) is the square root of 625 ;
(*d*) is the square root of none of the above.

Better : 25 is the square root of
(*a*) 5 ; (*b*) 2×5 ; (*c*) 625 ; (*d*) none of the three

(*iii*) When an incomplete-statement format is used, the options should come at the end of the statement. Students' continuity in reading should not be impaired and confusion should not result.

Poor : The cube of (*a*) 2 (*b*) 3 (*c*) 4 (*d*) 5 is the square of 8.

Better : The square of 8 is the cube of (*a*) 2, (*b*) 3, (*c*) 4, (*d*) 5.

(*iv*) Arrange the alternatives as simply as possible. Alternatives should not be placed in a run-on fashion. List them in alphabetical order if a single word, in ascending or descending order if numerals, or by length of response. This makes it easier for the students to read the material.

(*v*) Avoid highly technical distractors. Avoid using unfamiliar and difficult vocabulary or symbols.

(*vi*) All responses should be plausible and homogeneous. No distractor should be automatically eliminated by the students because it is an irrelevant or a stupid answer.

Poor : Which of the following men invented the telephone ?
(*a*) Bell ; (*b*) Euclid ; (*c*) Morse ; (*d*) Pasteur ; (*e*) Marconi.

Here, for the distractors to be plausible, all should deal with inventors in the field of communications who lived at about the same time. Euclid was a mathematician, while Pasteur was a bacteriologist. These two distractors are irrelevant and, therefore, not plausible.

Better : Which of the following men invented the telephone ?
(*a*) Bell ; (*b*) Edison ; (*c*) Morse ; (*d*) Marconi.

(*vii*) The correct answer should not be consistently longer or shorter than the distractors. (The correct answer often is longer than the incorrect distractors.)

(*viii*) Avoid giving irrelevant clues to the correct answer ; *e.g.*, length of the answer, grammatical clues, a key word in the stem repeated in the correct opinion, etc.

Poor : Which of the following diseases is caused by a virus ?

(*a*) Gallstones

(*b*) Scarlet fever

(*c*) Typhus fever

(*d*) Typhoid fever

(*e*) Viral pneumonia.

The clue is *virus* in the stem and *viral* in response(e). Again, the item is also defective in that the gallstones is not a disease.

Poor : Thomas Edison was an

(*a*) Financier ; (*b*) Journalist ; (*c*) Inventor ; (*d*) Politician.

Here, *an* is the clue to the correct response *Inventor*.

Better : Who was Thomas Edison ?

(*a*) Financier ; (*b*) Journalist ; (*c*) Inventor ; (*d*) Politician.

(*ix*) There should be one and only one correct or best answer to every item.

Poor : Choose the one who does not belong in the group ;

(*a*) J. Bose ;

(*b*) Sarojini Naidu ;

(*c*) Pasteur ;

(*d*) Rabindranath Tagore.

Here, all the responses are, in one way or other, correct. The pupil may select (*a*), the only Indian scientist in the group, or (*b*), the only woman in the group, or (*c*), the only bacteriologist in the group, or (*d*), the only Nobel Prize-winner in the group.

Such items should be avoided, because quite often even experts may disagree about the correct answer.

(*x*) Avoid using "all of the above" as an option. "None of the above" can be used sparingly, but with care.

(*xi*) Use four or five options. The larger the number of plausible distractors, the greater the reliability of the test item. The number of distractors to be used should be governed by such factors as

(*a*) the age of the children tested,

(*b*) the nature of the material being tested.

(*c*) the time available for testing.

(*xii*) Whenever an item reflects an opinion, some authority must be cited.

Poor stem : Which one of the following defines *Personality* ?

Better stem : According to our text, which one of the following defines *Personality* ?

(*xiii*) Avoid overlapping options.

Poor : The *Quit India Movement* was started

(*a*) before the Second World War started ;
(*b*) before India got independence ;
(*c*) after 1950 ;
(*d*) after 1960.

The choices are really between (*b*) and (*c*). If (*a*) is correct, (*b*) must also be correct. If (*d*) is correct, (*c*) must also be correct. So, this is really a two-option rather than a four-option item.

Better : The *Quit India Movement* was started

(*a*) before India got Independence ;
(*b*) between 1930 and 1940 ;
(*c*) after India got independence ;
(*d*) between 1950 and 1960.

(*xiv*) The correct answer should follow a random order.

(*xv*) To measure the higher mental processes, cast the item in a novel situation. For example,

The objects of the same height are placed before a concave mirror between its F and C. The images will be

(*a*) at the same place having the same size ;
(*b*) at the same place having different sizes ;
(*c*) at different places having the same size ;
(*d*) at different places having different sizes.

(*xvi*) Use the MC item where most appropriate. For example, for computational problems in Mathematics and science, the short-answer format is appropriate. Where facts and/or opinions are to be measured, the T/F items should be used. When it is difficult to write plausible distractors, but there are many homogeneous items, the matching test is superior. The MC format has a wide applicability, but it is not always the best choice.

14.6 The Context-Dependent Items

Items that are based on an external source—be it pictorial or verbal—are called *context-dependent*. A teacher—interested in learning whether his pupils can read and interpret a graph or a table, interpret a poem or a short story, identify a painting, recognise a musical composition, read the dials on an electrical equipment and the like—would provide this material to the student, who would then use it as his frame of reference to answer items based on this external material.

(A) Objective Test Item Based on Pictorial Materials

The pictorial form is a medium used to present the material to the examinee. It is *not* an item format. Different item formats may be used with pictorial materials.

Uses

(*i*) It is very useful for younger children and those having reading difficulties.

(*ii*) For measuring a young child's ability to count, to measure and to discriminate, pictorial material is an excellent medium.

(*iii*) For measuring some of the more complex skills—such as reading a graph, using an income-tax table, or using an index—pictorial material is ideally suited.

(*iv*) Where a picture is equal to the use of many hundreds of words, the pictorial form should be employed.

Advantages

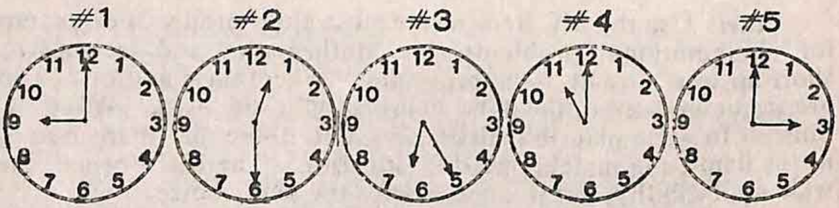
(*i*) It lends a degree of realism to the test situation.
(*ii*) It introduces an element of novelty and interest.

Why are Pictorial Materials Seldom Used in Teacher-made Tests ?

It is because (*a*) good and relevant pictorial materials are hard to find and (*b*) pictorial materials often have to be adapted slightly, but most teachers are not artistically inclined.

T/F Test Items

Directions : In the picture below, there are five clocks. Below the picture some statements are given. With reference to the picture, if they are right, encircle T, if wrong encircle F.



(*i*) The time shown in clock 2 is 12.30. T F

(*ii*) After five minutes the time shown in clock 3, the measure of the angle formed by the two hands, will decrease. T F

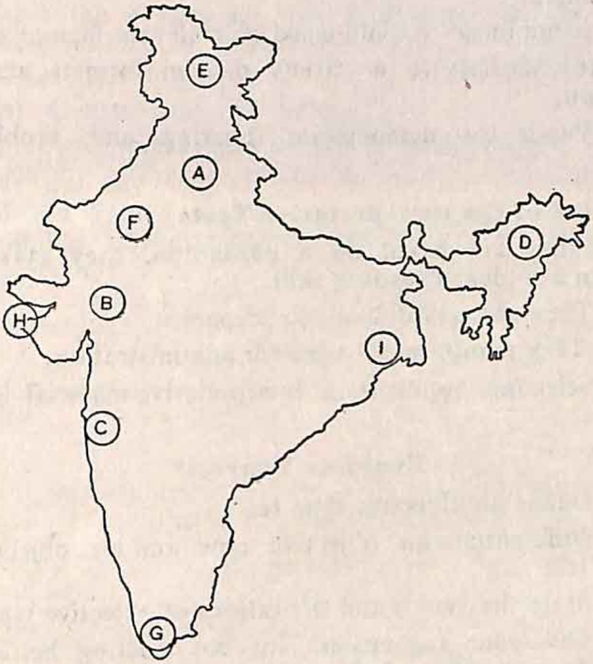
Short-Answer Test Items

(*i*) What time is shown by clock 5 ?

(*ii*) Which clock shows the time that is closest to 8 o'clock ?

Multiple-Choice Test Items

Items 21 through 24 have reference to the letters locating certain places on the map of India.



(*xxi*) Which is the place that is know as *The Gateway of India* ?
1.A ; 2.B ; 3.C ; 4.D ; 5.E.

(*xxii*) Which of the following designated places shows a desert area ?
1.E ; 2.F ; 3.G ; 4.H.

(*xxiii*) Which is the place that receives the highest rainfall in the whole world ?
1.B ; 2.C ; 3.D ; 4.E.

(*xxiv*) The capital of India is shown by which letter ?
1.A ; 2.C ; 3.E ; 4.G.

(B) The Interpretative Test

It consists of either an introductory statement, pictorial material or a combination of the two, followed by a series of questions that measure in part the student's ability to interpret the material. The reasons for its growing popularity are :

(*i*) The structuring of the problem assists both examiner and examinee.

(*ii*) It lends itself to the measurement of understanding, interpretation and evaluation.

(*iii*) Complex material can be measured with a series of different items based upon a single introductory passage, graph, chart or diagram.

(*iv*) It minimises the influence of irrelevant factual material.

(*v*) It lends itself to a variety of item formats and modes of presentation.

(*vi*) Pupils can demonstrate thinking and problem-solving skills.

Limitations of the Interpretative Tests

(*i*) If they are based on a paragraph, they make a heavy demand on a student's reading skill.

(*ii*) They are very difficult to prepare.

(*iii*) They require more time for administration.

(*iv*) Selecting appropriate interpretative material is somewhat difficult.

Evaluate Yourself

1. Define an objective type test.
2. Differentiate an objective type and an objective-centred test.
3. State the merits and limitations of objective type tests.
4. Give your suggestions for constructing better test items for each of the following cases :
    (*a*) Objective type test items (in general) ;
    (*b*) Short-answer items ;
    (*c*) T/F items ;
    (*d*) Matching tests ;
    (*e*) MC items.
5. State the advantages and limitations of
    (*a*) Short-answer items ;
    (*b*) T/F items ;
    (*c*) Matching tests ;
    (*d*) MC items ;
    (*e*) Interpretative tests.
6. With illustrations, explain the different variations of
    (*a*) Short-answer items ;
    (*b*) Alternate response items ;
    (*c*) Matching Tests ;

   (*d*) MC items.

7. What are the uses of matching tests ?
8. What are context-dependent items ?
9. State the advantages and limitations of the use of the pictorial form in evaluation.
10. Write short notes on :
    (*a*) Constructing MC items ;
    (*b*) Advantages and limitations of T/F items.
11. Mention any *three* specific objectives of teaching any *one* of the School subjects to class VIII, and prepare a suitable objective-based question under each of the objectives.

15

The Classroom Testing

TEACHER-MADE TESTS—III
(QUALITATIVE TECHNIQUES)

15.1 Classification of Qualitative Techniques

Evaluation based merely on quantitative measures cannot be considered complete and valid unless the qualitative aspect of pupil behaviour is also taken into consideration. Qualitative measures can be classified as :

(*a*) Observational Techniques.
(Tools : Participation charts, Check lists, Rating scales, Anecdotal Records.)

(*b*) Sociometric Techniques.
("Guess Who" technique, Sociogram—Nominating Technique—Social Distance scales).

(*c*) Self-Report Techniques.
(Tools : Interview, Inventories or Questionnaires, Attitude scales).

(*d*) Projective Techniques.
(Tools : Sentence completion, Doll play, Perception of ink-blots, Interpretation of pictures, etc.)

15.2 Observational Techniques

Classroom teachers continually observe their students. The observation, however, is typically informal and unsystematic, carried on without any benefit of specific planned procedures. It is important that it should be as accurate and reliable as possible.

The term *observational tools and techniques* are not synonymous, although they are used interchangeably by many persons. An observation technique generally implies the use of a particular observational tool such as a rating scale, a check list, etc. However, the process of observing and recording an individual's behaviour is what is meant by the phrase *observational technique*.

It is expected that the observer should be completely objective and record the actual behaviour without attempting to synthesise or interpret behaviour.

Advantages of Observation

(*i*) Frequent observations of a student's work and work habits can provide a continuous check on his progress.

(*ii*) The errors or problems, as they arise can be immediately detected and corrective action taken quickly.

(*iii*) Observational techniques are not so time-consuming or menacing for the pupil as are achievement tests.

(*iv*) Observational data provide teachers with valuable supplementary information, much of which could not be obtained in any other way.

Suggestions to Help Make Valid Observations

(*i*) Plan in advance what is to be observed.

(*ii*) The observer must be cognizant of sampling errors. There should be frequent, short observation distributed over a period of several weeks and at different times of the day.

(*iii*) Co-ordinate the observations with your teaching. Otherwise, there is great danger that invalid observations will result.

(*iv*) Record and summarise the observation immediately after it has occurred. More important, however, is the fact that when pupils know they are being observed, their resultant behaviour may be atypical.

(*v*) Make no interpretations concerning the behaviour until later on. Otherwise, it may interfere with the objectivity of gathering observational data.

(*vi*) Prepare some sort of list, guide or form to help make the observation process objective and systematic.

15.3. Types of Observational Tools

(A) Participation Charts

An important instructional and educational objective is to have students voluntarily participate in activities such as a debate, a group report, in athletics, etc. Yet this important objective is seldom evaluated in some systematic and rigorous fashion.

—Is Kishan a leader or a follower ?

—Does Neelam tend to engage in athletic activities more than in social activities ?

—Does Shakuntala tend to participate more in larger groups than in smaller groups ?

—Is Manish independent in his thoughts and convictions or does he tend to go along with the groups ?

By means of a participation chart, the teacher can plot a pupil's growth throughout the year and then make some evaluative judgement about his behaviour.

Remember that the data collected by means of a participation chart do not help explain the *why* of a particular behaviour.

Objective : Discussion of the *Axiomatic Approach in Modern Mathematics.*

		Group members				
		A	B	C	D	E
Extent of Contribution						
Significant :	(introduces new ideas)	///	/	///	//	//
Secondary :	(introduces important but minor ideas)	///	//	/	/	/
Doubtful :	(insufficient evidence to evaluate contribution)			/		
Irrelevant :	(introduces irrelevant ideas and contribution detracts from discussion).	/	/		///	

Here, pupil A dominated the discussion in that he raised or introduced eight points. Of these eight points, three points made a significant contribution to the discussion, four made a secondary contribution, while only one point was irrelevant. Note that D introduced six points, out of which three were irrelevant. E took the least part in the discussion.

The teacher engaged in evaluating pupil participation will be occupied in his task. Teachers using a participation chart should—

(*i*) try to rate participation in a *small* group setting rather than in large class discussions. It is difficult for a teacher to concentrate when many pupils are involved ;

(*ii*) only observe and not participate in the discussion. Noting and recording the behaviour of the participants is a full-time task ;

(*iii*) record the behaviour noted immediately after it has happened.

(B) Check Lists

A check list consists of a listing of steps, activities or behaviour which the observer records when an incident occurs. It is similar in appearance and use to a rating scale and is classified by some as a type of rating scale.

A check list enables the observer to note only whether or not a trait or characteristic is present. It does not permit the observer to rate the quality of a particular behaviour or its frequency of occurrence or the extent to which a particular characteristic is present. When such information is desired, the check list is definitely inappropriate.

Advantages of Check Lists

(*i*) They are adaptable to most subject-matter areas.

(*ii*) They are useful in evaluating those learning activities that involve a product, process and some aspects of personal-social adjustment.

(*iii*) They are most useful for evaluating those processes that can be sub-divided into a series of clear, distinct, separate actions.

(*iv*) When properly prepared, they constrain the observer to direct his attention to clearly specified traits or characteristics.

(*v*) They allow inter-individual comparisons to be made on a common set of traits or characteristics.

(*vi*) They provide a simple method to record observations.

(*vii*) They objectively evaluate traits or characteristics.

A specimen

Directions : Listed below are a series of characteristics related to health practices. Check those characteristics which are applicable to students.

Characteristics to be observed	Roll Nos. of the pupils								
	1	2	3	4	5	6	7	8	etc.
1. Take a balanced diet									
2. Washes before breakfast									
3. Brushes teeth after eating									
4. Drinks plenty of water at the time of eating									
5. Brushes teeth before going to bed									
6. Goes for a walk daily ; etc.									

Here is an example of a check list for constructing T/F items :

(*i*) Expresses each item in clear, simple language ;
(*ii*) Avoids lifting statements verbatim from the text ;
(*iii*) Avoids negative statements wherever possible ;
(*iv*) Makes sure that each item is clearly true or false ;
(*v*) Reviews the items independently.

A check list should not be used if a more discriminating procedure can provide a valid appraisal ; *e.g.*,

(*i*) Adds two digit numbers ;
(*ii*) Subtracts two digit numbers ;
(*iii*) Multiplies decimals.

These abilities may be evaluated with greater discrimination and objectivity through the use of written problems or a simple test.

While using check lists—

(*i*) Use check lists only when you are interested in ascertaining whether a particular trait or characteristic is present or absent ;

(*ii*) Clearly specify the traits or characteristics to be observed ;

(*iii*) Observe only one child at a time and confine your observations to the points specified on the check list ;

(*iv*) Have a separate check list for each child. Individual observations can be recorded on a master check list ;

(*v*) The observer must be trained how to observe, what to observe and how to record the observed behaviour. To make a valid judgement, he should omit recording those behaviours for which he has insufficient information.

(C) Rating Scales

Rating scales resemble check lists but are used when finer discriminations are required. Instead of merely indicating the presence or absence of a trait or characteristic, it enables us to indicate the degree to which a trait is present. Rating scales provide systematic procedures for obtaining, recording and reporting the observer's judgements. That may be filled out while the observation is made, immediately after the observation is made or, as often is the case, long after the observation.

Uses of Rating Scales

(*i*) They measure specified outcomes or objectives of education deemed to be significant or important to the teacher.

(*iii*) They evaluate *procedures* (such as playing on an instrument, working in the laboratory, typing, cooking, singing, oral reading, acting in a play), *products* (such as typed letters, a speech, written themes, samples of handwriting, art work), and *personal-social development*.

(*iii*) They help teachers to rate their students periodically on various characteristics such as punctuality, enthusiasm, cheerfulness, co-operativeness, consideration for others and other personality traits.

(*iv*) They can also be used by a pupil to rate himself.

A Word of Caution

Rating scales tend to be less reliable, valid and efficient than tests ; they should not therefore be used to evaluate outcomes that can be more easily and validly assessed through other procedures. Again, they are likely to reflect a teacher's bias concerning a student rather than the student's actual behaviour ; therefore, they should be used with care and caution.

Advantages of Rating Scales

(*i*) They can be used with a large number of students.

(*ii*) They tend to be very adaptable and flexible.

(*iii*) They can be efficient and economical in the use of a teacher's time.

(*iv*) They can be comprehensive in the amount of information recorded.

(*v*) They can help to reduce the subjectivity and unreliability that are usually associated with observation methods.

Types of Rating Scales

(*a*) Numerical Rating Scales

This is one of the simplest types of ratings scales. The rater simply marks a number that indicates the extent to which a characteristic or trait is present. The trait is presented as a statement and values from 1 to 5 (a maximum of 10) are assigned to each trait that is rated. Typically a common key is used throughout, the key providing a verbal description.

Direction : Encircle the appropriate number showing the extent to which the pupil exhibits his skill in questioning.

key : 5—outstanding 4—above average 3—average 2—below average 1—unsatisfactory.

Skill :

	1	2	3	4	5
(*i*) Questions were specific					
(*ii*) Questions were relevant to the topic discussed	1	2	3	4	5
(*iii*) Questions were grammatically correct, etc.	1	2	3	4	5

(*b*) Graphic Rating Scale

As in the case of the numerical rating scale, the rater is required to assign some value to a specific trait. This time, however, instead of using predetermined scale values, the ratings are made in a graphic form —a position anywhere along a continuum.

Direction : Rate for each characteristic listed below along the continuum from 1 to 5. You can use points between the scale values. Mark X at the appropriate place along the continuum.

1. Were the illustrations used interesting ?

1	2	3	4	5
Too little	Little	Adequate	Much	Too much

2. How attentive were you in the class ?

1	2	3	4	5
Very inattentive	Inattentive		Attentive	Very attentive

3. Did the speech show good organisation ?

1	2	3	4	5
Very poor		Average		Very good

Advantage : If a number of traits are rated on the same page with a common set of categories, a behavioural *profile* can be constructed.

(*c*) Descriptive Graphic Rating Scale

This type of scale is generally the most desirable type of scale to use.

Directions : As shown above for the graphic rating scale.

1. While preparing a blackboard summary, how was the penmanship ?

Legible, beautiful, Uniform size and slant	Normally readable, good-looking, fluent motion	Illegible, bad-looking, tends to draw outlines

Such specific descriptions contribute to a greater objectivity of the rating process. The description also helps to clarify and further define a particular dimension.

(*d*) Ranking

In the ranking procedure, the rater, instead of assigning a numerical value to each student with regard to a characteristic, ranks a given set of individuals from high to low on the characteristic this is rated. To ensure that the pupils are validly ranked, rank from both extremes towards the middle. This simplifies the task of the teacher. The ranking procedure becomes very cumbersome when a large number of students or characteristics per student are to be ranked.

Sources of Error in Rating Scales

There are several common sources of error in rating scales. All these sources affect the validity of a rating. Errors may be due to—

(*a*) Ambiguity ;

(*b*) The personality of the rater ;

  (*i*) Halo effect ;

  (*ii*) Personal bias ;

  (*iii*) Logical error ;

(*c*) Attitude of the rater ;

(*d*) Opportunity for adequate observation.

(*a*) **Ambiguity** : This refers to the wording and meaning of the traits that are measured, *e.g.*, To one rater, *aggressiveness* may be a positive trait suggesting self-assertion. To another it may connote hostility. The terms such as *honesty*, *effective and fruitful learning*, *intelligent citizen*, *personality*, *ideal character*, etc. must be clarified. Unless all pupils are rated on the *same* attributes, the rating will be invalid and unreliable.

Ambiguity in the frame of reference is another problem of rating scales. What do the words *superior*, *good*, *inferior*, really mean ? They are relative terms.

To reduce ambiguity, the behaviour to be measured should be broken up into a series of specific, observable and measurable traits by describing fully what each trait represents, and by giving example of the different kinds of behaviour associated with differing levels of the trait.

(*b*) **Personality of the Rater** : This refers the halo effect, personal bias (generosity error, severity error, central tendency error and logical error).

The halo effect occurs when a rater's general impression of a person influence his rating.

A generosity error is committed when a rater favours the high (desirable) end of the continuum—that is, when he is very lenient.

A severity error is committed when a rater favours the low (undesirable) end of the continuum—that is, when he is very harsh.

A central tendency error is committed when a rater avoids using extremes and favours the middle position—that is, rates everybody about average.

A logical error is closely related to the halo effect, but is not due to personal bias. It occurs when two traits, such as intelligence and socio-economic status, are closely related and the rater is influenced in his rating of one by the presence or absence of the other. Here, the rater *thinks* or may hold the false belief that highly intelligent persons possess a high socio-economic status.

(*c*) **Attitude of Raters :** Accurate observation is a very time-consuming process. Unless the raters truly believe that there is some value to be derived from ratings, they may consider them only as another administrative process and not to do a conscientious job.

(*d*) **Opportunity for Adequate Observation :** This is the most serious error. The error is committed when the rater does not know well enough the pupil he is rating. The only reasonable thing to do is to refuse to rate the pupil on those trait about which you have little or no knowledge.

Improving the Rating Scale

(*i*) Identify educationally significant traits.

(*ii*) Clearly define the traits to be rated and the scale points to be used.

(*iii*) Avoid technical jargon. If slang will help convey the intent, use it by all means.

(*iv*) Express the traits to be rated as questions rather than as declarative statements.

(*v*) If the line showing the continuum is used, it should follow immediately after the question.

(*vi*) Determine how discriminating you want the ratings and divide the continuum accordingly. (Three—to seven-point intervals).

Improving the Rater

(*i*) The rater should know (*a*) the value of accurate and honest ratings, (*b*) the kinds of errors commonly committed and how they may be avoided or at least minimised.

(*ii*) Motivate the rater to do as accurate a job as possible.

(*iii*) Select persons who can provide objective, unbiased ratings. Avoid persons who are either over critical or solicitous.

Factors Improving Validity of Rating

(*i*) Take care in the construction of the scale and the selection of the raters.

(*ii*) Encourage raters not to rate those traits or persons for which or for whom they have insufficient or no knowledge.

(*iii*) Average judges' ratings.

(*iv*) Rate only one trait or characteristics at a time.

(*v*) To reduce the halo effect, vary the direction of the scale ; that is, for some ratings, have the first position indicate a desirable trait, the last an undesirable trait, and vice versa.

(*vi*) Avoid making the extremes so atypical of behaviour that few raters will use these points.

(*vii*) Make the meaning of the intermediate levels closer to the neutral or average level rather than the extreme points.

(*viii*) The rater may be asked to quote instances in support of his judgement to avoid careless rating.

(D) Anecdotal Records

These are records of specific incidents, factual description of important and meaningful events or behaviour of students on informal occasions. Each event or behaviour is described shortly after it occurs.

Anecdotal records should possess certain characteristics :

(*i*) They should contain a factual description of *what* happened, *when* it happened and under *what circumstances* the behaviour occurred.

(*ii*) The interpretation and recommended action should be noted separately from the description.

(*iii*) Each anecdotal record should contain a record of a single incident.

(*iv*) The incident recorded should be one that is considered to be *significant* to the pupil's growth and development.

Anecdotes

December 10, 10.30 a.m.
Recess

1. Jagdish is seen in the Library, sitting in a corner, solving riders in Geometry.

December 15, 1.15 p.m.
Geometry Period

2. Jagdish is found to be the only boy responding to the teacher's questions on solving a rider.

December 21, 4.45 p.m.
Language period

3. Jagdish was caught reading a book "Fun in Geometry" during the language period and was asked to leave the room.

Interpretation : Jagdish is very much interested in Geometry.
Recommendation : Jagdish should be encouraged to do more in Mathematics, and also not to neglect languages.

Advantages of Anecdotal Records

(*i*) If properly used, they provide a factual record of an observation of a single, significant incident in the pupil's behaviour.

(*ii*) They record critical incidents of spontaneous behaviour (in a natural setting).

(*iii*) They provide the teacher with objective descriptions.

(*iv*) They are very good for young children who are unable to use pencil-and-paper tests.

(*v*) They direct the teachers' attention to a single pupil.

(*vi*) They provide for a cumulative record of growth and development.

(*vii*) They can be used by the counsellor as a source of information for giving guidance.

(*viii*) They provide more complete descriptions of behaviour better suited to understanding and guiding pupils than the other observational tools available.

(*ix*) They can be used as a supplement to quantitative data. This leads to a better understanding of a pupil's behaviour.

Limitations of Anecdotal Records

(*i*) They tend to be less reliable than other observational tools as they tend to be less formal and systematic.

(*ii*) They are time-consuming to write.

(*iii*) It is difficult for the observer to maintain objectivity when he records the incident observed.

(*iv*) When incidents are noted and read out of context, they may lose their meaning.

(*v*) The observers tend to record only undesirable incidents and neglect the positive incidents.

(*vi*) They present only a verbal description of the incident. They do not *reveal causes*.

Making Anecdotal Records Effective

(*i*) Restrict observations to those aspects of behaviour which cannot be evaluated by other means.
(*ii*) Concentrate on only one on two behaviours.
(*iii*) Observation should be selective.
(*iv*) An observational blueprint or guide should be prepared in advance.
(*v*) Records should be complete.
(*vi*) They should be kept by all teachers and not only by the child's classroom teacher.

(*vii*) Record the incident or action as soon as possible after it has happened.

(*viii*) They should be compiled and filed.

(*ix*) They should have an interpretative value.

(*x*) They must be available to specified school personnel.

(*xi*) They should be emphasized as an educational resource.

(*xii*) They should not be confined to recording negative behaviour patterns. They should be recorded regardless of the direction of behaviour.

(*xiii*) The teacher should have practice and training in making observations and writing anecdotal records.

(E) Cumulative Records

A cumulative record is a permanent record of a student which is kept up-to-date by the school. It is the educational history with information about his (*a*) academic achievement, (*b*) attendance, (*c*) intelligence, (*d*) health report, (*e*) likes and dislikes, (*f*) hobbies, (*g*) preference for a vocation, (*h*) personality traits, etc.

These data are useful in understanding a child, and help the teacher to evaluate a child thoroughly.

15.4 Sociometric Techniques

Sociometric techniques are useful in evaluating the personal-social adjustments of a pupil. Sociometry is concerned with how an individual is seen and accepted by his peers. Sociometric techniques have been and are constantly being used by students. When they elect their monitor, choose sides for a game, select the best student of the year, they are employing sociometry.

The essential point is to devise a series of questions that will elicit a student's *true* feelings about other members in his class ; *e.g.*

(*i*) Whom would you like to sit next to in class ?

(*ii*) Who is your best friend ?

(*iii*) Whom would you like to play indoor games with ?

Advantages of Sociometric Techniques

(*i*) They reveal information about the personal-social adjustments of students.

(*ii*) They are quite economical in time and money.

Using Sociometric Data

Teacher can use these data—

(*i*) (*a*) for organising classroom groups, (*b*) to improve the social climate in the classroom, (*c*) to improve the social structure of the group, (*d*) to help those who have been isolated become more acceptable to their peers.

(*ii*) To study the effects of certain experiences on a group structure ;

(*iii*) To study the relationship between a group structure and such factors as sex, religion, colour, age ;

(*iv*) To study the stability of a group structure.

Limitations of Sociometric Data

(*i*) The data are only as valid as the rapport that exists between the student and teacher and the student's willingness to be honest.

(*ii*) The data only reveal relationships. They do not establish causal relationships.

(*iii*) The relationships are not necessarily stable, since social situations change rapidly.

Teacher-made Sociometric Techniques

The following are some of the teacher-made sociometric techniques :

(A) Peer Appraisal ("Guess Who" technique) ;
(B) Nominating Procedures (Sociogram) ;
(C) Social Distance Scales.

(A) Peer Appraisal Methods

A peer appraisal can be a very good supplement in the evaluation programme. In evaluating such characteristics as *popularity*, *leadership ability*, *concern for others*, fellow students are often better judges than teachers.

Whenever peer ratings are desired, two major principles must be adhered to :

(*i*) The traits to be rated should be within the student's experiental background.

(*ii*) Complete anonymity and confidentiality must be maintained.

(A) "Guess Who" Technique

Each pupil is given a list of descriptions and asked to name the pupil(s) who best fit(s) each description. One may include one's own name if one believes the description suits one ; *e.g.*,

(*a*) This boy is an effective leader, always sides with the students if they are right, strong and stout, a good orator.

(*b*) This girl is very friendly with boys, plays with boys, sits in the group of boys, reads with boys.

The teacher can readily see which pupils are mentioned most frequently, seldom, or not at all for each characteristic.

(B) Nominating Technique (A Sociogram)

This is very similar to the *guess who* method except that the questions are slightly different. Instead of choosing a name to fit a description, the student is asked to nominate the person(s) with whom he would like to work, sit, study, or play.

This technique provides data relevant to the existing social relationships in the class. With this technique, we are interested in *who made* the nomination as well as *who was nominated.* Reciprocal relationships are looked for.

Instruction : On a piece of paper, write your name first and, under it, mention names of three persons, in order of preference, with whom you would like to study.

Although the choice can be weighted, it would be preferable to use a simple count rather than a weighting procedure.

The results are tabulated in a matrix, and a graphic picture of the data matrix (the sociogram) is prepared. From the sociogram, we can identify the students who are most popular (stars), those who receive no choices (isolates), and those who receive only a single choice (neglectees).

(C) Social Distance Scales

In the sociogram, the student is generally restricted to the number of choices he can make. Because of this restriction, we do not have a complete picture of the group's social structure. To determine the extent to which the group accepts or rejects Bharat, or conversely, the extent to which Bharat accepts each member in the group, the social distance scale is used.

In the social distance scale, every child reacts to every other child in respect of the questions asked. A simple tally then provides the teacher with sociometric data for the total group.

15.5 Self-Report Techniques

For evaluation purposes, the wealth of information about the student is usually obtained from him by interviews and questionnaires (inventories). These techniques are used to gather data by obtaining responses to questions.

(A) Interviews

The interview is a face-to-face personal conference, in which the required information is obtained directly from an individual.

There are at least three main aspects to the technique of interviewing.

(*i*) Parts of an interview :

(*a*) *A beginning* (establishing rapport and clarifying the purposes of the interview) ;

(*b*) *A middle* (data gathering or exploration of alternative solutions to a problem) ;

(*c*) *An end* (summarising and terminating the face-to-face relationship).

(*ii*) Securing Responses :

(*a*) *Structured or controlled interview* : (Here, there is an attempt to cover a definite ground. Schedules of questions are generally drawn up beforehand).

(*b*) *Unstructured or uncontrolled interview* : (Here, conditions are least controlled. The interviewer raises various questions orally with the interviewee and takes advantage of the flexibility and informality of the situation).

(*iii*) Recording Results :

The teacher takes brief notes during the course of the interview and summarises the main points after the interviewee leaves. With the consent of the interviewee, a tape recorder may be used.

Advantages

(*i*) It provides for flexibility. It allows the interviewee to ask for a clarification of a question and the interviewer to raise all kinds of follow-up questions to the answers of the respondent. The interviewer can skim over certain areas and probe others intensively.

(*ii*) It lends itself to dealing with confidential and personal material which cannot be obtained through a questionnaire.

(*iii*) It gives the interviewer the opportunity to hear *how* an interviewee has said something (*e.g.*, accent, fluency, tone of voice, meaning, etc.) as well as what he has said.

(*iv*) An informal interview on how Vijay solves an arithmetic problem may reveal to the teacher what techniques of thinking Vijay employs.

(*v*) Quietly chatting with a student at his seat, the teacher can gather valuable information about him.

(*vi*) The interview is a face-to-face situation. Here two people enter into a structural conversation. To this extent the interview is a familiar, real-life situation.

(*vii*) It enables each side to have a look at the other. No employer would like to take an employee without seeing him, nor an employee would like to join a firm without meeting somebody from the firm.

(*viii*) The interview is a method acceptable to both sides. An unacceptable selection method *e.g.* tests of intelligence etc. could cause considerable initial tension which might impair performance.

(*ix*) The skilfully-handled interview, provides a highly flexible situation. Different approaches can be tried.

(*x*) The interview is relatively quick and economical.

Limitations

(*i*) There is always a chance that time will be wasted, unnessary questions raised, irrelevant materials covered, or that a constructive person-to-person relationship cannot be sustained because of the personality of either the interviewer or the interviewee.

(*ii*) It is time-consuming.

(*iii*) It makes it possible for an interviewer to ride a personal hobby.

(*iv*) Its utility depends on the *willingness* of the interviewee to give honest answers.

(*v*) It cannot be used in group situations.

(*vi*) Lack of definite aim or purpose in the interview.

(*vii*) The candidate is not allowed to develop a theme. Instead of that there are too many questions which can be answered in one word.

(*viii*) Asking questions which only elicit information already possessed by the interviewer through application forms, confidential reports etc. This only shows that the interviewer has no clear idea of procedure.

(*ix*) Asking the questions in such a tone that the candidate is led to believe that the question must be answered in a certain way.

(*x*) Restricting the time so much that there is no real chance of making maximum use of the interview possibilities.

(*xi*) Sometimes the interviewee is unduly influenced by the views and techniques of the other interviewers.

(*xii*) Failure by interviewers to discuss techniques of interviewing among themselves.

Uses

This technique is widely used in guidance and counselling, in getting information regarding a child's interests, needs, adjustments, etc.

(B) Inventories or Questionaries

A questionaire is a list of planned written questions related to a particular topic or series of topics. Space is provided for the reply to each question.

In the structured (*close-end*) type of questionaire, the answers are checked or underlined by the respondent. In the unstructured (*open-end*) type, the respondent is allowed to make free responses to the questions. The inventory comes under the first type.

In practice, when we want to collect the respondent's family data, personal data, health data, special school activities, educational and vocational plans, etc., we call the questionaire a questionnaire. When we want to evaluate the respondent's interests, attitudes, opinions, feelings and other personal social adjustments, we present him a series of questions or statements in the form of a check list. Such self-report techniques are generally referred to as inventories.

Constructing Questionnaires or Inventories

The following points should be observed :

(*i*) Use the questionnaire or inventory when it is most appropriate, *e.g.*, when

- (*a*) the group may soon break up because it is temporary ;
- (*b*) the group is together for the first or last time ;
- (*c*) there is insufficient time for individual interviews ;
- (*d*) there are too many to be interviewed ;
- (*e*) there are too many people who can't be reached personally ;
- (*f*) an independent response from each person is desired ;
- (*g*) the desired data are either non-existent or not conveniently available ;
- (*h*) answers to a comparable set of questions are desired ;

(*ii*) Define the general purposes and specific objectives ; *e.g.*,

- (*a*) To secure background data on an individual (or group) which may be valuable in accounting for classroom behaviour ;
- (*b*) To secure a pencil-and-paper aid in evaluating the extent to which educational objectives are being realised ;
- (*c*) To secure data which will be pertinent to planning a curriculum ;

(*d*) To secure a picture of the status of an experience, a unit, a project, a study or a group.

(*iii*) Construct appropriate questions or statements :

(*a*) A question or statement should be clearly stated. A clear question is one whose (*a*) vocabulary is understandable, (*b*) phrasing is simple and straightforward, (*c*) terms are unequivocal, and (*d*) print is readable.

(*b*) It should not be double - or triple-barrelled.

(*c*) Do not confine the respondent to a choice which does not describe his position ; *e g.*,

Poor : When you sew, do you prefer a sewing machine ( ) or a needle ( ) ? Check one.

Better : Do you sew ? Yes/No.
If yes, do you prefer a sewing machine ( ) or needle ( ) ? (Check one.)

(*d*) Do not include too many questions or statements.

(*e*) They should be so written as to facilitate the tabulation and presentation of findings.

(*iv*) Arrange questions or statements in appropriate groupings. This is to ensure a *mind-set* and to make the tabulation more systematic and interpretation of the question simpler.

(*v*) Design an appealing format. It must be well-printed, well spaced and attractive-looking, which encourages the respondent to answer questions fully and with interest.

(*vi*) Check the questionnaire or inventory for adequacy. This is to eliminate spelling, grammatical and typographical errors.

Administering the Questionnaire or Inventory

For good administration, the conditions are—

(*a*) insuring a good climate for proper administration ;
(*b*) stating clear purposes ;
(*c*) providing clear directions and a good working situation.

Specimen

(*i*) (A sample of physical and health education inventory)

Directions : If you agree with the statement, encircle A ; if you disagree, encircle D ; if you are uncertain, encircle U. There is no time limit.

A U D (*a*) I enjoy playing badminton.
A U D (*b*) I like to learn a course in *First Aid*.
A U D (*c*) I would like to play the game which includes boys and girls.

(*ii*) (A sample from Bell's Adjustment Inventory)

Directions : If your answer is positive, encircle *yes* ; if negative, encircle *no* ; if you are uncertain, encircle ? There is no time limit.

Yes No ? (*a*) Do you enjoy social gatherings because you want to be with other people ?

Yes No ? (*b*) Does criticism disturb you greatly ?

Yes No ? (*c*) Are you often in a state of excitement ?

(C) Attitude Scales

Attitudes are a result of the socialisation process. They influence an individual's responses to objects, situations, other persons and groups of persons. By knowing a person's attitude to an object, one can predict his reaction to that class of objects. Attitudes are not fixed but are quite malleable. There is a positive correlation between attitudes and learning.

Attitudes are not directly observable but are inferred from one's overt behaviour, both verbal and non-verbal.

Attitude scales are highly susceptible to taking and therefore should be used with care. Nevertheless, they can often be used by the classroom teacher to obtain a better understanding of his pupils.

Specimen

(A sample extracted from Remmer's Attitude Scale)

A scale for measuring attitude towards any teacher

Name of the teacher to be rated————.

Directions : Place a + sign against each statement with which you agree with reference to the above-named teacher. Mark only those statements which you know to be true about the teacher.

——(*a*) Is perfect in every way.

——(*b*) Makes the subject interesting.

——(*c*) Grades papers fairly.

——(*d*) Is always polite.

——(*e*) Can talk well on many subjects, and so on.

15.6 Projective Techniques

While self-report structured inventories require the subject to describe himself, projective techniques call upon the individual to interpret objects other than himself. These objects may be pictures, incomplete sentences, drawings and the like.

They can be classified into five types :

(*i*) Associative Techniques (Rorschach Ink-Blot Test) ;

(*ii*) Constrution Procedures (Thematic Apperception Test) ;

(*iii*) Completion Tasks (Rotter's Incomplete Sentence Test) ;

(*iv*) Ordering Devices (Szondi Test) ;

(*v*) Expressive Methods (Machover's Draw-A-Person Test).

Projective tests are so named because they induce the subject to project himself into the test situation and thus reveal his feelings, motives, attitudes, apprehensions and aspirations.

Both projective tests and self-report inventories share many things in common :

(*a*) They have a relatively low validity and reliability.

(*b*) They provide some of the information needed to obtain a better understanding of the individual.

(*c*) They can be administered either individually or in groups.

Projective tests may also be differentiated from self-report inventories in many other ways :

Projective tests—

(*a*) normally present unstructured stimuli ;

(*b*) are more resistant to faking ;

(*c*) are interesting and novel and hence can easily be used with young children or with individuals who are afraid of a formal pencil-and-paper test ;

(*d*) can be either verbal or non-verbal and hence can be applicable to illiterate and very young children ;

(*e*) are very susceptible to subjective feelings of the scorer even when certain guidelines are used in the scoring ;

(*f*) are usually based upon or reflect o psycho-analytic theory such as that of Jung or Freud.

All the various types of projective tests have the following features in common :

(*a*) They present the individual with a non-structured situation, which may be ambiguous and neutral ;

(*b*) They all catch the subject off guard. He is instructed that it is a test of his imagination. As the subject does not know what is being tested, the test is hard to fake ;

(*c*) They make little or no demand on literacy or academic skills ;

(*d*) They preserve the unity and integration of the total personality.

Evaluate Yourself

1. Classify the qualitative techniques under various heads.
2. What are the advantages of observational techniques ?
3. Give suggestions to make valid observations.
4. What are the types of observational tools ? Write fully on any two of them.
5. What are the advantages of check lists ? What points should be remembered while using check lists ?
6. Mention the uses and advantages of rating scales.
7. What are the different types of rating scales ? Describe one, giving illustrations.
8. What are the sources of error in rating scales ? Describe them fully.
9. Give your suggestions for improving the rating scale and the rater.
10. How will you improve the validity of rating ?
11. What are anecdotal records ? Mention the advantages and limitations of anecdotal records. How will you make anecdotal records effective ?
12. What are sociometric techniques ? Mention some uses and limitations of sociometric data. Which are the teacher-made sociometric techniques. Describe any one of them.
13. Write short notes on :

    (*a*) .interviews ; (*b*) Questionnaires or Inventories.
14. Which points will you observe while constructing questionnaires or inventories ?
15. What are the necessary conditions for the good administration of a questionnaire or an inventory ?

16. Write a short note on : Attitude Scales.
17. What are projective techniques ? What are the common points of projective tests and self-report inventories ? How are projective tests different from self-report inventories ?
18. What are the features of projective tests ?
19. Enumerate the tools of evaluation of instructional objectives. Illustrate the use of any *one* of them.
20. Illustrate the use of five point rating scale.
21. What are the different techniques of Evaluation ? Write in detail the significance of any one of them.
22. What is the difference between structured and non-structured interviews ?

16

Internal Assessment

16.1 Why Internal Assessment ?

(*i*) In education, evaluation plays an important role. It has become an integral part of the instructional programme. The total concept of educational evaluation includes not only quantitative assessment but also qualitative assessment and value judgement. This cannot be done by any external body or board of examination alone. Internal assessment can be helpful here.

(*ii*) During the course of teaching-learning process, a variety of educational decisions are taken. Without a regular and systematic internal assessment, these decisions cannot be given effect to.

(*iii*) The main emphasis in evaluation is the pupils' progress in learning. A glimpse of this progress can be had with help of an internal assessment programme.

(*iv*) Educational evaluation does not merely aim at improving the system of examination, which may be its limited function. Internal assessment is not a substitute for but a supplement of these external examinations. Together with external examinations it gives us a comprehensive picture of the students' learning. Thus, internal assessment improves the teaching-learning process itself.

(*v*) Objectives of the affective domain (attitudes, interests and appreciation) and psychomotor domain (skills), *e.g.*, long-ranged objectives, require for their achievement a long process of continuous observation, testing and recording. Naturally, such a technique can only be followed in internal assessment.

(*vi*) If we believe in the principle that there is a place for oral tests, observational, sociometric and self-reporting techniques and other types of testing in educational evaluation, then internal assessment is a *must*.

(*vii*) With the introduction of unit tests, the weightage given to the annual examination or the external examination is, no doubt, reduced ; still, it is more than necessary.

(*viii*) Unit tests function as motivating factors for students to study. Intermittently, a knowledge of the result also motivates students.

(*ix*) Unit tests, by way of internal assessment also provide a basis for feedback. Diagnostic and remedial teaching are possible and would be more scientific if there is internal assessment.

16.2 How Internal Assessment Should be Made

The system of internal assessment is of great significance and should be given increasing importance.

(*i*) Internal assessment should be comprehensive, evaluating all the aspects of the students' growth, *e.g.*, academic achievements, personality traits, achievement of objectives from all the three domains—cognitive, affective and psychomotor.

(*ii*) The Education Commission (1964-66) recommends : "Internal assessment should be built into the total educational programme and should be used for improvement rather than for certifying the level of achievement of the student."

(*iii*) All the items of internal assessment need not follow qualified scoring procedures. Some of them may be assessed in descriptive terms. The result should be kept separately and not be combined artificially with other results to form aggregate scores.

(*iv*) The system of internal assessment should be such as to help us in changing the attitudes of students favourably towards the day-to-day school programme.

(*v*) Internal assessment should be such as to supplement the final examination.

(*vi*) Internal assessment should be, as far as possible, very objective, unbiased and based on all the records of unit tests, oral tests, practical tests, homework, class work, observational scales and inventories, participation in social and cultural activities, in group projects, etc.

16.3 Components of the Internal Assessment System

The following components (*i.e.*, items and tools) of this system should be considered while implementing it in schools and colleges. The school should provide as many activities as possible, and detailed records of students' participation should be scrupulously maintained. The items of activities may be as follows (This is merely a sample. Many more activities can be added) :

Items and Tools of Internal Assessment

Item of Assessment	*Tools for Assessment*	*No. of Tests in a Year*
(*i*) *Periodical Tests*	*Written Tests*	Unit tests depend on the number of units.
(*a*) Unit tests	(*a*) Standardised unit tests	Two term tests
(*b*) Term tests	(*b*) Teacher-made tests	
(*ii*) Oral Tests (mostly for languages)	Interview technique	Two (once in a term)
(*iii*) *Laboratory work*	Practical tests	Two (once in a term)
Practical tests (for science)	Observational techniques	
(*iv*) *Library work*	Observational techniques	Two (once in a term)
Reading and preparing notes	Interest inventories	and casual inspection
(*v*) *Term papers*	Written assignments	Two (once in a term) per subject
(*vi*) *Study habits*		
(*a*) Home work	Written assignments	Continuous in day-to day teaching. At least ten assignments in each subject
(*b*) Regular assignments	Written assignments	
(*vii*) Participation in sports/games	Observation	At least two sports activities
	Cumulative record card	

(*viii*) *Co-curricular activities* (*a*) Debates (*b*) Elocution (*c*) Drawing (*d*) Music (*e*) Mimicry (*f*) Dramatics (*g*) School magazine (*h*) Exhibition	Interest inventories Rating scales	At least two activities
(*ix*) *Study Circles* (*Clubs*) (*a*) Language (*b*) Science (*c*) Mathematics (*d*) Social studies	Interest inventories Rating scales Check lists	At least in one study circle
(*x*) *Personality tests* Co-operation Initiative Honesty Leadership Followership	Observational techniques Rating scales Check lists Questionnaires, inventories, Standardised tests	During the whole year
(*xi*) *Visits* (*a*) Educational visits (*b*) Hikes and excursions (*c*) Picnics	Interest inventories Questionnaires, Check lists	Once per term Twice per term Once per term

16.4 Weightage to Items of Internal Assessment

Due weightage should be given to the different items mentioned above. Below is given a sample. It is subject to change, depending upon the school programme and many other things.

(A) Subject-wise Assessment

The suggested weightage is given below :

Unit Tests	25
Two term tests	25
Performance tests	10
Home work and class work	10
Term papers (two per subject)	10
Assignments (ten in each subject)	20
	100

The final maximum score in a subject should be 100. A student must obtain a minimum score of 50 in order to gain promotion to the next higher standard.

(B) Assessment of Co-curricular Activities

Here, subject-wise assessment is not possible. The suggested weightage is given below :

(*i*)	Library work	20
(*ii*)	Sports and games (at least two activities)	20
(*iii*)	Debates, elocution, drawing, music, etc. (at least two activities)	20
(*iv*)	Study circle (any one)	20
(*v*)	Visits (excursions, educational visits, hike, etc.)	20
		100

A student must obtain a minimum score of 50 in order to gain promotion to the next higher standard.

(C) Assessment of Personality Traits

Here, the assessment in terms of scores is not possible. Various grades may be assigned to different traits as suggested below :

Traits	**(very much)**				**not at all**
Co-operation	A	B	C	D	E
Initiativeness	A	B	C	D	E
Honesty	A	B	C	D	E
Leadership	A	B	C	D	E
Followership	A	B	C	D	E
Perseverence	A	B	C	D	E
Confidence	A	B	C	D	E

More traits may be added.

With the help of this scheme, percentage scores or grades may be determined and reported separately. The minimum expected score or grade for promotion to the next higher standard should be made known to the pupils.

16.5 Validity of Internal Assessment

Through internal assessment is a powerful tool in the hands of a teacher, there is a likelihood of its misuse. It becomes invalid if the teacher is biased, has prejudice against a pupil, shows favouritism or antagonism towards a pupil. The tool of internal assessment is a very good tool if the assessment is made objectively and is free from bias.

16.6 Advantages of Internal Assessment

(*i*) No undue weightage is given to the final or annual or external examination. This is logical, psychological and scientific.

(*ii*) Proper study habits are likely to be developed ; *e.g.*

  (*a*) Students will be engaged in study throughout the year ;

  (*b*) They will be more regular, alert, sincere in their studies ; *e.g.*, in doing classwork, homework, assignments ;

  (*c*) Undue emphasis on eleventh-hour preparations, in most of the cases cramming, will be reduced to the minimum.

(*iii*) Students will pay attention to all the activities organised by the school, and they will try to participate in these activities.

(*iv*) Internal assessment helps us to minimise anxiety and nervous breakdown on the part of students, which otherwise are possible at the time of the final examination.

(*v*) It gives us a comprehensive picture of a pupil's progress.

(*vi*) It helps as to diagnose the weaknesses and strength of pupils. On the basis of this, remedial teaching is possible.

(*vii*) It can be used as a good device for motivating students.

(*viii*) It brings about a change in the attitude, interests and appreciation of students and teachers towards school programmes.

(*ix*) It gives an ample opportunity to the teacher to assess his own students. It is completely in accordance with the principle : "The teacher who teaches should assess."

(*x*) If internal assessment has a considerably high weightage in the promotion of a student to the next higher standard, not only teachers but students and even parents should feel more responsible for the entire syllabus during the whole year.

16.7 Disadvantages of Internal Assessment

With all the advantages mentioned above, internal assessment has some disadvantages too.

(*i*) It may be misused by a teacher.

(*ii*) It can cause a great harm in the hands of an inexperienced, insincere, inefficient and dishonest teacher.

(*iii*) It will lose its validity if favouritism, personal prejudices and subjectivity in assessment are rampant.

16.8 Conclusion

In an ideal situation, cent per cent internal assessment does have a place in the teaching-learning process ; but, in practice, it is not so because of some very serious limitations. Internal assessment may not replace the external examination, but it can very well supplement it. External examinations came into existence only when teachers failed to carry the responsibility of assessing their pupils objectively, honestly and free from prejudice.

Evaluate Yourself

1. Why is internal assessment necessary ?
2. Describe what type of internal assessment would be most useful.
3. Prepare a chart showing the components of the internal assessment system.
4. Prepare a plan showing the weightage given to the different items in the internal assessment scheme.
5. Discuss the advantages and disadvantages of internal assessment.
6. Discuss the factors that affect the validity and reliability of internal assessment.

PART II

USEFUL STATISTICAL METHODS

Modern problems and needs have pushed statistical methods and statistical ideas into the forefront. There are many things a teacher wishes to know about the performance and progress of his pupils. The teacher also wishes to be able to compare one group with another, as well as one individual with another or one individual with another of his age or sex or class.

This cannot be discovered by a single observation or by a single measurement. Psychologists have devised a number of tools for measuring human characteristics. Any attempts to describe, summarise or compare the results of individuals or of group calls for a numerical treatment. This ultimately requires a knowledge of elementary statistical methods, which involve a numerical treatment of the collected data and which help us interpret psychological and educational measurements.

The following pages are for teachers whose primary interest is psychological or educational. Only those vital points are discussed here which may prove to be very useful to classroom teachers while evaluating their pupils' performance and progress in various fields.

I. THE FREQUENCY DISTRIBUTION

Useful Terms in Statistics

Sample : Suppose you are interested in finding out the average height of VII-grade boys in the State of Maharashtra. It is physically impossible for you to measure the height of *all* of them. You will study *only a group* of VII-grade boys. This group is called a *sample*.

Thus, the group under actual study is called a *sample*.

Sample Study : The study of only a sample is known as *sample study*.

Statistic : You would record the height of the students of your sample. You would, then, find out their average height. This average height is known as *statistic*.

Statistics : To find out the average height, average weight, average age, average marks, etc., and other measures like mean, median, mode, standard deviation, coefficient of correlation, etc., is known as *Statistics*.

In short, measures computed from a sample or samples are known as *statistics*.

The Frequency Distribution

Grouping Scores into a Frequency Distribution

It is difficult to make sense out of ungrouped data until they have been arranged or classified in some systematic way. As a result of a systematic analysis or classification of data, scores become meaningful.

In the following example, we have five categories, *viz.*, very good, good satisfactory, fair and poor.

Lesson remarks	**Students (Roll Nos.)**	**Frequency**
Very Good	7, 18	2
Good	1, 8, 12, 19, 23, 25	6
Satisfactory	2, 3, 5, 6, 9, 10, 14, 15, 22, 24	10
Fair	11, 16, 17, 20	4
Poor	4, 13, 21	3

The number of objects or scores or individuals in a category is known as *frequency*. By grouping scores into classes, that is, by classifying scores we have what is called a *Frequency Distribution.*

The following scores were obtained by VIII-grade students in a Mathematics test :

Table 1. Scores on a Mathematics Test

31, 20, 14, 26, 36, 49, 28, 37, 25, 32, 43, 15,
40, 32, 28, 20, 24, 27, 27, 23, 31, 27, 32, 36,
24, 27. 32, 26, 45, 22, 12, 30, 29, 16, 50, 10,
25, 16, 24. 34, 42, 26, 20, 44, 18, 28, 26, 41,
35, 28, 26, 22, 33, 32, 26, 21, 25, 38, 44, 18.

Do these scores give us a clear picture of how the pupils fared in the test ? If we arrange them either in ascending or descending order, a somewhat better picture will emerge. Still, they do not clearly reveal the general pattern.

Frequency distribution would make the data even more interpretable. One may group the data or combine different scores into class intervals.

Steps in Preparing Frequency Distribution

(*a*) **Determine the Range :** The difference or gap between the highest and the lowest score in the series is called the *range* of the series. In the above series, the range is 50—10=40. The range is useful in determining class intervals.

(*b*) **Determine the Class Intervals :** The second step is to settle upon the number of groups into which you would like to group the data or to combine different scores. These groups are known as *class intervals* (C.I.). The number of class intervals will automatically affect the size of each class interval. As regards to their size and number, no definite rule exists. There are, however, some general guidelines for determining class intervals :

(*i*) Always remember that a broader interval loses more details and crowds the scores into coarse categories, while a narrower interval loses the benefit of grouping.

(*ii*) The size of the class interval should be an odd number so that the midpoint of the interval is a whole number. This makes some types of computation easier and facilitates graphing.

(*iii*) Start the class interval at a value that is a multiple of that interval. For example, if the interval is 5, the lowest class interval should start with a multiple of 5. If the interval is 4, the lowest class interval should start with a multiple of 4 ; and so on.

(*iv*) Remember that the theoretical limits of the class interval 65—69 is 64.5—69.5 and of 81—90 is 80.5—90.5, etc.

(*c*) **Tabulate the Scores :** This is done in two steps. The first one is to *tally* the scores in their proper intervals and the second is to count the tallies and find out the frequency of each class interval. The sum of the frequency is called N.

Tabulation of scores given in table 1 is shown below :

Table 2. Frequency Distribution Table

Class Intervals (CI)	Tallies	Frequency (f)
10—14	III	3
15—19	𝍸	5
20—24	𝍸 IIII	9
25—29	𝍸 𝍸 𝍸 III	18
30—34	𝍸 𝍸 I	11
35—39	𝍸	5
40—44	𝍸 I	6
45—49	II	2
50—54	I	1
		N=60

(*i*) The range being 40, we can have 20 C.I. of size 2, or 15 C.I. of size 4, or 12 C.I. of size 4, or 8 C.I. of size 5, or 4 C.I. of size 10, etc. We have, however, selected 9 C.I. of size 5.

(*ii*) As the interval is 5, the lowest C.I. taken is a multiple of 5, *i.e.*, 10.

Limitations of Frequency Distribution

(*a*) Some information is lost. For example, the scores of 15, 16, 16, 18 and 18 have all been put in the interval 15—19 (14.5—19.5). Again, one cannot say which exact measures have been included, say, in the interval 30—34.

(*b*) From table 2, one does not know the score of the 25th student in the series.

(*c*) For further calculations, one has to assume that either (*i*) the scores are uniformly distributed over the theoretical limits of the interval, or (*ii*) all scores fall on the midpoint of the interval. The degree to which such assumptions affect the accuracy of the graphs and statistics computed from a class interval depends upon the size and number of class intervals and the total frequency of the scores.

Advantages of Frequency Distribution

(*a*) It makes data easier to interpret.

(*b*) It gives one a fairly clear picture of how students have performed. For example, the largest group has got the scores between 25 and 29, while the majority of the group have scored between 20 and 34.

(*c*) If Meena's score is 46, we can estimate her relative position in the group and can express our qualitative judgement about her position.

(*d*) It increases the clarity of the form of the distribution of scores.

Limits of Class Intervals

There are various ways in which the limits of class intervals are expressed. Study the following methods :

Method A	Method B	Method C
40—50	40—49	39.5—49.5
50—60	50—59	49.5—59.5
60—70	60—69	59.5—69.5
....	....	....

All the three methods express the same facts ; but we may choose the one we like. Method B is more exact than method A but less so than method C, which shows the theoretical limits of C.I., which are expressed in integral limits. Method B is the best one.

The Midpoint of an Interval

The midpoint of a C.I. can very easily be found out by averaging integral limits or theoretical limits. For example, the midpoint of the C.I. 50—59 is $\left(\frac{50+59}{2} \text{ or } \frac{49.5+59.5}{2}\right)$ 54.5 ; that of 71—73 is 72, that of 85—89 is 87, etc.

II. GRAPHIC REPRESENTATION

The data displayed in Table 2 may also be graphed in various ways, *viz*., the histogram, the frequency polygon, etc.

Advantages of Graphic Representation

(*i*) It helps greatly in enabling us to understand the data of frequency distributions.

(*ii*) It helps us in analysing numerical data.

(*iii*) It helps us in comparing different frequency distributions to each other.

(*iv*) It catches the eyes and holds the attention which other statistical evidences fail to attract.

(*v*) It helps us to dilute the abstractness of ideas by translating numerical facts into a more concrete and understandable form. It permits easy visualisation.

The Histogram

It is a graph in which the frequencies are represented by bars or columns. It appears as a series of bar graphs placed one next to the other in a vertical array.

Fig. 1 displays the data of Table 2 in the form of a histogram.

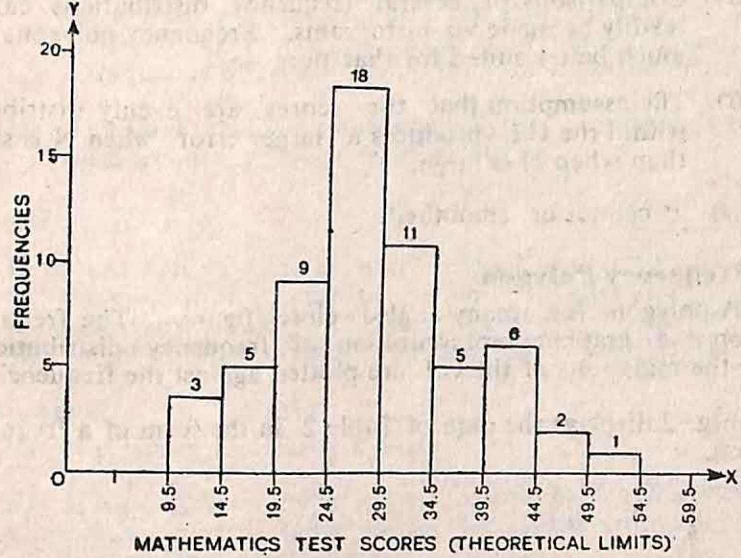


Fig. 1. Histogram of the Mathematics Test Scores.

Notice the following properties of the histogram :

(*i*) Frequencies are along the vertical axis and the scores (C.I.) are along the horizontal axis.

(*ii*) One assumes that the scores are evenly distributed within the class interval, thus giving us rectangular bars.

(*iii*) The frequencies within each interval of a histogram are represented by a rectangle, the size of the interval being the base and the frequency of that interval the height.

(*iv*) The area of each rectangle in a histogram corresponds to the frequency within a given interval, while the total area of a histogram corresponds to the total frequency (N) of the distribution.

Advantages

(*i*) It is simple and easily made.

(*ii*) All the five advantages of the graphic representation as shown above are applicable here.

Limitations

(*i*) It is difficult to superimpose more than one histogram on the same graph.

(*ii*) Comparisons of several frequency distributions cannot readily be made via histograms. Frequency polygons are much better suited for that purpose.

(*iii*) The assumption that the scores are evenly distributed within the C.I. produces a larger error when N is small than when N is large.

(*iv*) It cannot be smoothed.

The Frequency Polygon

A polygon is a many-angled close figure. The frequency polygon is a graphic representation of frequency distribution in which the midpoints of the C.I. are plotted against the frequencies.

Fig. 2 displays the data of Table 2 in the form of a frequency polygon.

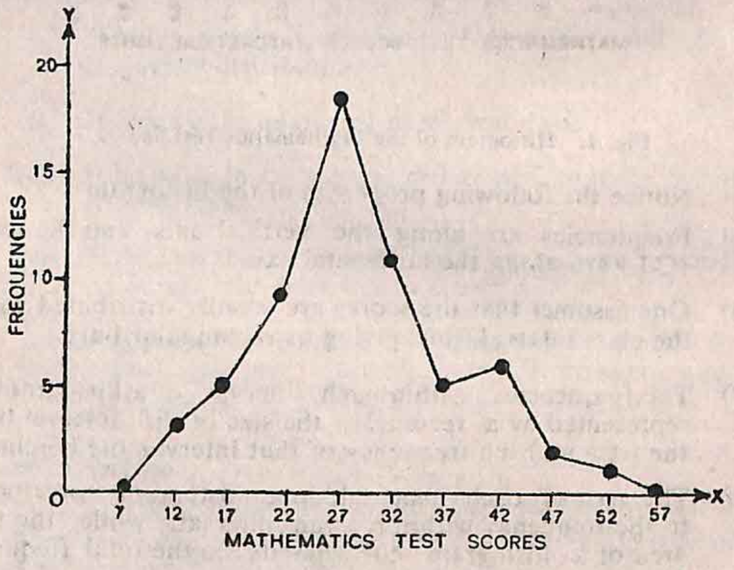


Fig. 2. Frequency Polygon of Mathematics Test Scores.

Notice the following properties of the frequency polygon :

(*i*) Frequencies are along that vertical axis and the scores (representing the midpoints of C.I.) are along the horizontal axis.

(*ii*) One assumes that all scores within a class interval fall at the midpoint of that interval.

(*iii*) The midpoint of the class intervals just above and below the highest and lowest intervals that contain the actual scores are also marked on the horizontal axis and given a frequency of zero. This is done to close the figure.

(*iv*) The total area of a frequency polygon corresponds to the total frequency (N) of the distribution.

75% Rule

In order to give symmetry and balance to the polygon, care must be exercised in the selection of unit distances on both the axes. A good general rule is to select X and Y units which will make the height of the figure approximately 75% of its width.

Advantages

(*i*) It is simple and easily made.

(*ii*) It is possible to superimpose more than one frequency polygon on the same graph by using coloured lines, broken lines, dotted lines, etc.

(*iii*) Comparisons of several frequency distributions can readily be made via frequency polygons.

(*iv*) All the five advantages of the graphic representation as discussed above are applicable here.

(*v*) It can be smoothed.

Limitations

(*i*) The part of the area lying above any given interval cannot be taken as, proportional to the frequency of that C.I. owing to irregularities in the frequency surface.

(*ii*) The assumption that all the scores within a C.I. fall at the midpoint of the interval produces a larger error when N is large than when N is small.

(*iii*) It is less precise than the histogram in that it does not represent accurately, *i.e.*, in terms of area, the frequency upon each interval.

Smoothing the Frequency Polygon

(A) A frequency polygon should be smoothed—

(*i*) To iron out chance irregularities ;

(*ii*) To get a better notion of how the figure may look if data were more numerous ;

(*iii*) To know how a polygon would look if grouping errors and sampling errors are removed from it ;

(*iv*) To ascertain the shape which it would take if it represents conditions freed from minor accidental fluctuations.

(B) How to Smooth a Frequency Polygon :

In smoothing, a series of *moving* or *running* averages are taken, from which new or adjusted frequencies are determined. To find an adjusted or smoothed *f*, add the *f* on the given interval and the *f*'s on the two adjacent intervals (the interval just below and the interval just above) and divide the sum by 3. For example, the smoothed *f* for interval 25—29 is (9+18+11)/3=12.67, that for interval 45—49 is (6+2+1)/3=3.00.

(Data from Table 2)

Class intervals (scores)	*f*	smoothed *f*
5—9	0	1.00
10—14	3	2.67
15—19	5	5.67
20—24	9	10.67
25—29	18	12.67
30—34	11	11.33
35—39	5	7.33
40—44	6	4.33
45—49	2	3.00
50—54	1	1.00
55—59	0	.33
	60	60.00

Note that—

(*i*) We have to take two more C.I. one 5—9 and the other 55—59, for which the *f* is taken as 0. Their smoothed *f*, in each case, is (0+0+3)/3=1.00 and (1+0+0)/3= .33 respectively.

(*ii*) The inclusion of these last two intervals makes N=60.00 for the smoothed distribution.

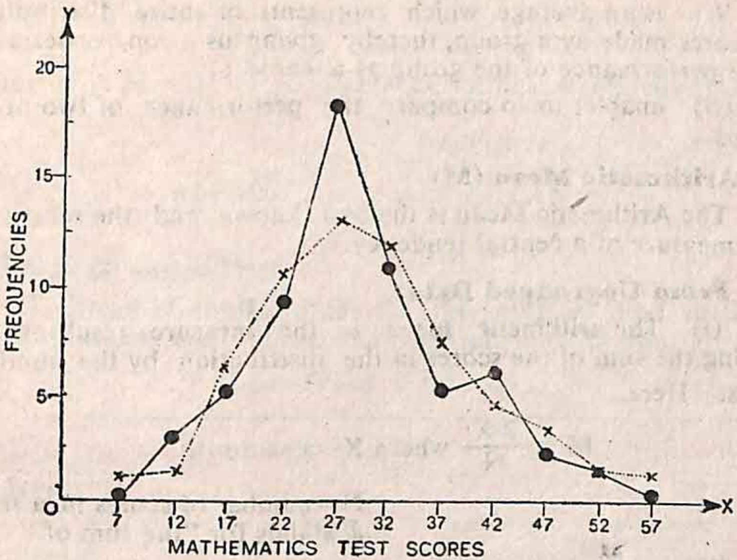


Fig. 3. Original and Smoothed Frequency Polygons (Data from Table 2).

If N is large, smoothing may not greatly change the shape of a graph, and hence is often unnecessary.

III. MEASURES OF CENTRAL TENDENCY

Statistical series may differ from one another in the following three ways :

(*i*) Values of the variable, round which most of the scores cluster ;

(*ii*) Extent to which scores are dispersed round the central value ;

(*iii*) Extent of departure from a normal distribution.

Accordingly, there are three measures designed to study the above differences :

(*i*) Measures of the first order (measures of central tendency or averages) ;

(*ii*) Measures of the second order (measures of dispersion or variability) ;

(*iii*) Measures of the third order (Skewness, Kurtosis, etc.).

Averages

There are two types of averages :

(*i*) Mathematical Averages ; *e.g.*, Arithmetic Mean, Geometric Mean, Harmonic Mean.

(*ii*) Averages of Position ; *e.g.*, Mean, Mode.

The value of a measure of a central tendency—

(*i*) is an average, which represents an entire distribution of the scores made by a group, thereby giving us a concise description of the performance of the group as a whole ;

(*ii*) enables us to compare the performance of two or more groups.

The Arithmetic Mean (M)

The Arithmetic Mean is the best known and the most widely used measure of a central tendency.

(A) From Ungrouped Data

(*i*) The arithmetic mean is the measure resulting from dividing the sum of the scores in the distribution by the number of scores. Here,

$$M=\frac{\Sigma X}{N} \text{ where } X=\text{a score}$$

N=number of scores in a series ;
Σ stands for "the sum of."

Thus, the arithmetic mean or, more simply, the mean of the scores 93, 90, 89, 88 and 86 is 446/5=89.2.

(*ii*) There is another *short-cut method*. Let us assume that the mean in the above series is 89. Find out the deviation of each score from the mean. It will be 4, 1, 0, −1, −3, respectively. Add them. Use the following formula :

$$M=X+\frac{\Sigma x^1}{N} \text{ where } X=\text{assumed mean ;}$$

x^1=deviations from the assumed mean.

In our case, $M=89+\frac{1}{5}=89.2$

(*iii*) Study the following example, in which the data are in a discrete series :

No. of Children born per family X	No. of Families f	fx	x^1	fx^1
0	96	0	−2	−192
1	108	108	−1	−108
2	154	308	0	
3	126	378	1	126
4	95	380	2	190
5	21	105	3	63
	600	1279		79

$$M=\frac{\Sigma fx}{N}=\frac{1279}{600}=2.13$$

Short-cut : $M=X+\frac{\Sigma f x^1}{N}$ (fx^1=deviations weighted by their frequencies)

$$=2+\frac{79}{600} \qquad =2+0.13=2.13.$$

(B) From Grouped Data

(*i*) **Long Method.** Study the following method in which the data are grouped in a frequency distribution :

(Data from Table 2)

C. I. *Scores*	Midpoints (X)	*f*	*fX*
10—14	12	3	36
15—19	17	5	85
20—24	22	9	198
25—29	27	18	486
30—34	32	11	352
35—39	37	5	185
40—44	42	6	252
45—49	47	2	94
50—54	52	1	52
		N=60	1,740

Mean $=\frac{\Sigma fX}{N}$, fX=midpoints weighted by their frequencies

$$=\frac{1740}{60}=29.0$$

Procedure : Find out the midpoint of each C. I. These midpoints are then multiplied (weighted) by their frequencies. Divide the sum of fX by N. We shall then get the mean of the scores.

(*ii*) Study the following short method for calculating the mean, known as *Assumed Mean Method* :

(Data from Table 2)

C.I. Series	Frequency (f)	Deviation x^1	Product fx^1	
10−14	3	-3	-9	
15−19	5	-2	-10	
20−24	9	-1	-9	-28
25−29	18	0		
30−34	11	1	11	
35−39	5	2	10	
40−44	6	3	18	
45−49	2	4	8	
50−54	1	5	5	52

AM=27.00 Correction in interval units, $c=\frac{\Sigma fx^1}{N}=\frac{24}{60}=0.4$

ci=2.00 Correction in score units=ci=$0.4\times5=2.00$ (i is the interval length).

True Mean = AM+ci
=27.00+2.00
=29.00

Procedure

(*i*) Assume a value for the mean. We have selected the midpoint 27 of the C. I. as the assumed mean.

(*ii*) Lay off the deviations from the AM by class intervals, considering the direction of the class interval from the AM.

(*iii*) Multiply each f with the respective x^1 to get fx^1.

(*iv*) Find out the algebraic sum of fx^1. We have $(-28)+(52)=24$.

(*v*) Obtain correction in interval units and then in score units.

(*vi*) Find the true mean with the help of the formula :

$$\text{Mean}=\text{AM}+ci$$

Note that the correction may be negative, zero or positive. Again, this procedure requires the midpoint of only one class interval, which contains the assumed mean.

(C) Mean from Combined Samples

Suppose, on a *reading readiness test*, the investigator gets the following data :

	N	*M*
Sample A	20	52
Sample B	40	56
Sample C	25	50

What will be the mean of the three groups combined ?

The formula for the weighted mean of *n* groups is :

$$M\ \text{comb} = \frac{N_1\,M_1 + N_2\,M_2 + \ldots + N_n\,M_n}{N_1 + N_2 + \ldots + N_n}$$

where N_1, N_2, N_3,...are the number of cases in each group,

M_1, M_2, M_3,...are the means of the respective groups.

Substituting the values given in the above example,

$$M\ \text{comb} = \frac{(20\times52)+(40\times56)+(25\times50)}{20+40+25} = \frac{4530}{85}$$

$$=53.3$$

Merits of Arithmetic Mean

(*i*) It is rigidly defined, and a biased investigator will get the same mean from the series as an unbiased one. Its value is always definite.

(*ii*) It can be accurately determined with the help of various methods.

(*iii*) A mean is an algebraic measure which is capable of further algebraic treatment. It is useful in computing standard deviation, correlation, etc.

(*iv*) It is simple to follow. It is very easily understandable.

(*v*) If the number of items in a series is large, the mean provides a good basis of comparison.

(*vi*) A mean has an important property, and that is that the sum of the deviations of all the scores from the mean is *always* zero. In this respect, the median does not qualify.

Limitations of the Mean

(*i*) As the skewness of the distribution increases, the reliability of the mean decreases.

(*ii*) Since it is calculated from all the items of a series, sometimes the abnormal items may considerably affect the mean, particularly when the number of items is not large. For example, the mean of Rs. 275 is not at all a representative figure of Rs. 1,000, Rs. 25, Rs. 35, and Rs. 40.

(*iii*) If a single item of a series is missing, the mean cannot be calculated. If out of 500 items, the values of 499 items are known, the mean cannot be calculated. Other averages, such as the median and the mode, do not need complete data.

(*iv*) A mean gives greater importance to the bigger items of a series and less importance to the smaller items. One big item among five, four of which are small, will push up the mean considerably. Thus, the mean has an upward bias. But the reverse is not true. If in a series of five items, four of which are big and one item small, the mean will not be pulled down very much ; *e.g.*, the mean of items 25, 50, 75, 100 and 850 is 220, while the mean of items 500, 525, 550, 575 and 50 is 440.

(*v*) Sometimes the mean gives fallacious conclusions ; *e.g.* Income of two groups of persons :

A group : Rs. 1000, Rs. 100, Rs. 75, Rs. 25.

B group : Rs. 325, Rs. 300, Rs. 285, Rs. 290.

For both the groups, the mean is Rs. 300. It would appear that both the groups are economically at the same level, but this is not really so.

(*vi*) Unless the data are very simple, the mean cannot be located merely by inspection, while the median and the mode can be.

(*vii*) It cannot be accurately determined in the case of an open-end table. (A open-end table is that which does not provide exact scores of the extreme 4 or 5 cases.)

(*viii*) A mean can be used only with distributions that give absolute scores. It cannot be used with scores expressing grades or ranks or order of students, such as A, B, C, D,........

(*ix*) A mean can be a figure which does not exist in the series at all.

(*x*) A mean sometimes gives such results as appear almost absurd ; *e.g.*, 3.4 children.

When to use a mean

Use the mean...

(*i*) When the scores are distributed symmetrically around the central point, *i.e.*, when the distribution is not badly skewed. M is the centre of gravity in the distribution and each score contributes to its determination ;

(*ii*) When the measures of a central tendency having the greatest stability and reliability are wanted ;

(*iii*) When other statistics (*e.g.*, SD, coefficient of correlation) are to be computed later.

The Median (Mdn)

A median is the average of position. It is often called the counting average. It is the value or a point on the score scale that separates the top half of the series from the bottom half. It can be defined like this : "The median is the point below which 50 % of the scores lie."

(A) From Ungrouped Data

When ungrouped scores or measures are arranged in the order of their size, the median is the midpoint in the series.

(*i*) Find the median of the scores 24, 21, 30, 18, 27, 28, 30. Here N is odd. Arranging there seven scores in order of size we get,

18, 21, 24, 27, 28, 30, 30.

The median is 27.0, for there are three scores above and three below 27.0.

(*ii*) Find the median of the scores 24, 21, 30, 18, 27, 28. Here N is even. Arranging these six scores in order of size, we get,

18, 21, 24, 27, 28, 30.

Here there are two middle scores, 24 and 27. The average of these two, .*e*., (24+27)/2=25·5, is the median.

In short, median is the (N+1)/2th measure in order of size.

(B) From Grouped Data

When scores in a continuous series are grouped into a frequency distribution, the median is the 50 % point in the distribution. It is that point which has 50 % scores on each side of it.

(Data from Table 2)

C.I. Scores	Frequency *f*	
10—14	3	
15—19	5	
20—24	9	17
25—29	18	
30—34	11	
35—39	5	
40—44	6	
45—49	2	
50—54	1	
	N=60	
	N/2=30	

N=60, and therefore, N/2=30.
The median falls in the interval 25-29.
The lower limit of this interval l=24.5. The number of cases below the median interval, F=17.
Frequency within the median interval. f=18.
Size of the class interval, i=5.

$$\text{Median}=l+\left(\frac{N/2-F}{f}\times i\right)$$

$$=24.5+\left(\frac{30-17}{18}\times 5\right)$$

$$=24.5+3.6$$

$$=28.1$$

Procedure

(*i*) Find N/2.

(*ii*) Count downward into the distribution by adding successive frequencies until a number exactly equal to N/2, or as closely approaching it as possible without exceeding it, is reached. (If N/2 is exactly reached, the median is usually the upper real limit of the interval, the frequency of which was last added in the counting process. However, if the next higher interval should happen to have a zero frequency, the median is the midpoint of that interval. Again, if the next two higher intervals should happen to have a zero frequency, the median is the upper real limit of the interval containing the first zero frequency.)

(*iii*) Determine the correction :

(*a*) In terms of scores : $N/2-F$

(*b*) In terms of class interval : $\frac{N/2-F}{f}$

(*c*) In terms of scale distance : $\frac{N/2-F}{f}\times i$

(*iv*) Add the correction to the lower real limit of the interval in which the median lies.

$$\text{Mdn}=l+\left(\frac{N/2-F}{f}\times i\right)$$

Merits of the Median

(*i*) It is an ideal average, for it is rigidly defined.

(*ii*) It is easily understood without any difficulty.

(*iii*) It is not affected by the values of the extreme items (*i.e.,* skewness) and as such is sometimes more representative than the mean.

If the incomes of five persons are Rs. 300, Rs. 350, Rs. 400, Rs. 450 and Rs. 10,000, the median would be Rs. 400, whereas the mean would be Rs. 2,300. The median in such cases is a better average.

(*iv*) In the case of an open-end table, where the values of the extremes are not known, the median can be calculated if the number of items is known.

(*v*) The median can be used not only with distributions that give absolute scores such as 25, 30, 32, etc., but also with scores expressing grades or ranks or order of students, such as A, B, C, D,.....

(*vi*) When the units of measurement are unequal, the median is preferable. It does not assume equality of units, whereas the mean does assume it.

(*vii*) The median never gives absurd or fallacious results.

(*viii*) It can be located in many cases merely by an inspection.

Limitations of Median

(*i*) A median is a non-algebraic measure and hence not suitable for further algebraic treatment.

(*ii*) It cannot be used for computing other statistical measures such as SD, or coefficient of correlation.

(*iii*) The arrangement of items in the ascending or descending order is sometimes very tedious.

(*iv*) When there are wide variations between the values of different items, a median may not be representive of the series ; *e.g.*,

Marks : 15, 16, 16, 18, 18, 20, 54, 60, 70, 70, 82.

The median is 20, which is not representive of the series.

(*v*) When a median has to be calculated in continuous series, it requires interpolation. The assumption of the interpolation that all the frequencies of the class interval are uniformly spread over their values in the class interval may not be actually true. In most cases, it will not be true.

(*vi*) If big or small items in a series are to receive greater importance the median would be an unsuitable average, for it ignores the values of extreme items.

(*vii*) A median is more likely to be affected by the fluctuations of sampling than the mean.

When to use a Median

(*i*) When the exact midpoint—the 50% point of the distribution—is wanted ;

(*ii*) When there are extreme scores which would markedly affect the mean. They do not disturb the median ;

(*iii*) When it is desired that certain scores should influence the central tendency ;

(*iv*) When the distribution has an upper or lower class interval of unspecified length ;

(*v*) When a distribution is described and interpreted in terms of percentiles, it is used as a member of the percentile system.

The Mode

The *crude* or *empirical* mode (inspection average) is the most frequently occurring score in the distribution. For example, in the series 30, 31, 31, 32, 32, 32, 35, 37, 37, 40, the most often recurring measure 32 is the crude or empirical mode. It, however, can be greatly influenced by chance fluctuations or a sampling error, and is seldom used.

When data are grouped into a frequency distribution, the crude mode is usually taken to be the midpoint of that interval which contains the largest frequency. For the distribution given in Table 2, the mode is 27.0.

A distribution may have more than one mode. It may be unimodal or bimodal or multimodal.

The true mode is the point (or peak) of greatest concentration in the distribution. When the distribution is not badly skewed, the approximation of the true mode can be calculated by the formula :

$$\text{Mode} = 3\ \text{Mdn} - 2\ \text{Mean}$$

Merits of the Mode

(*i*) It possesses the merit of simplicity. In a discrete series, the mode can be located even by inspection.

(*ii*) It is commonly understood. A mode is an average which people use in their day-to-day expressions ; *e.g.*, sale of a commodity, size of families, etc., are expressed in their mode values.

(*iii*) Unlike the mean, it cannot be a value which is not found in the series.

(*iv*) A mode is not affected by the values of extreme items, provided they adhere to the natural law relating to extremes.

(*v*) For the determination of a mode, it is not necessary to know the values of all the items of a series.

Limitations of the Mode

(*i*) A mode is ill-defined, indeterminate and indefinite, and so untrustworthy.

(*ii*) It is not based on all the observations of a series.

(*iii*) It is not capable of further mathematical treatment.

(*iv*) It may be unpresentative in many cases. A slight change in the series may extensively disturb the mode. For example, in the series, 20, 25, 25, 25, 30, 60, 70, 95, 95, 100, the mode is 25. If one student gets 26 instead of 25 and one gets 95 instead of 100, the mode will be shifted to 95.

(*v*) The mode is affected by changes in the grouping scheme, while preparing frequency distributions.

(*vi*) In ungrouped data, if no score is repeated, it may lead to the wrong conclusion that the series has no mode.

(*vii*) As there may be 2, 3, or more modal values, it becomes impossible to set a definite value of a mode.

When to Use a Mode

Use a mode—

(*i*) When a quick and approximate measure of a central tendency is all that is wanted ;

(*ii*) When the measure of a central tendency should be the most typical value.

IV. MEASURES OF VARIABILITY

Need

The average has its own limitations and even an ideal average can represent a series only *as best as a single figure can*. Averages fail to reveal the entire story of a phenomenon. There may be a dozen series whose means may be identical, but which may differ from each other in a hundred ways. Obviously, in such cases, further statistical analysis of the data is necessary so that these differences may also be studied and accounted for. If this is done, the statistical analysis would be more accurate and we shall be more confident of our conclusions.

Study the following series :

A—40, 40, 40, 40, 40, 40, 40, 40, 40	Mean 40
B—36, 37, 38, 39, 40, 41, 42, 43, 44	Mean 40
C— 1, 9, 20, 30, 40, 50, 60, 70, 80	Mean 40

It is evident that the extent of the scatter round an average should also be studied to throw more light on the composition of a series. The name given to this scatter is *spread* or *dispersion* or *variability*.

Variability

Variability refers to the spread of the separate scores around a measure of a central tendency. If the spread is substantial, the variability is said to be considerable ; if the spread is little it is insignificant. For example, a series from 100 to 1000 has more dispersion than the one from 100 to 200.

Measures of variability are called measures of the *second* order because in their calculation, we average the values derived from the measures of the first order (*i.e.*, mean, median, mode). All the measures of variability represent distances rather than points ; and the larger they are, the greater is the variability of the scores.

The measures of variability are (A) the range, (B) the quartile deviation, (C) the average deviation and (D) the standard deviation.

(A) The Range

It is the difference between the highest score and the lowest score in a given series.

It is one of the least reliable measures of variability, for it is affected by fluctuations in the extreme scores.

Its only merit is that it can be easily calculated and readily understood.

Limitations of the Range

(*i*) It helps us to make only a rough comparison of two or more groups for variability.

(*ii*) It takes account of only the two extreme scores of a series and is unreliable when N is small or when there are large gaps (*i.e.*, zero *f*'s) in the frequency distribution.

(*iii*) It is affected very greatly by fluctuations in sampling. Its value is never stable. In a class where normally the height of students ranges form 150 cm to 180 cm, if a dwarf, whose height is 90 cm is admitted, the range would shoot up from 90 cm to 180 cm.

(*vi*) The range does not take into account the composition of a series or the distribution of the items within the extremes. The range of a symmetrical and an asymmetrical distribution can be identical.

Use the Range—

(*i*) When a knowledge of extreme scores is all that is wanted ;

(*ii*) When the data are too scant or too scattered to justify the computation of a more precise measure of variability.

(B) The Quartile Deviation or Q

The median divides an arrayed series into two equal parts. The values of items in one part are more than the value of the median and the values of items in the other part are less than the value of the median.

With a view to having a better study of the composition of a series, it may be necessary to divide it in three, four, six, seven, eight, nine, ten, or hundred parts. Usually, a series is divided in four, ten or hundred parts. One item divides the series in two parts, three items in four parts (quartiles), nine items in ten parts (deciles) and ninety-nine items in hundred parts (percentiles).

There are, thus, three quartiles, nine deciles and ninety-nine percentiles in a series. The second quartile, or the fifth decile or the 50th percentile is the median.

The value of the item which divides the first half of a series (with values less than the value of the median) into two equal parts is called the *First Quartile* (Q_1) or the *Lower Quartile*. In other words, Q_1 is a point below which 25% of the scores lie. Q_1 is the 25th percentile.

The *Second Quartile* (*Mdn*) or the *Middle Quartile* is the median. In other words, it is a point below which 50% of the scores. lie. A median is the 50th percentile.

The value of the item which divides the latter half of the series (with values more than the value of the median) into two equal parts is called the *Third Quartile* (Q_3) or the *Upper Quartile*. In other words, Q_3 is a point below which 75% of the scores lie. Q_3 is the 75th percentile.

The *Quartile Deviation* (Q) is one half the scale distance between the *Third Quartile* (Q_3) and the *First Quartile* (Q_1).

$$Q = \frac{Q_3 - Q_1}{2} \quad \text{Where } Q_3 = l + \left(\frac{\frac{3}{4}N - F}{f} \times i \right),$$

$$Q = l + \left(\frac{\frac{1}{4}N - F}{f} \times i \right)$$

where F=No. of cases below the quartile interval, f=frequency within the quartile interval.

$Q_3 - Q_1$ gives us the *Inter-Quartile Range* (IQR). The Quartile Deviation is the midpoint of the *Inter-Quartile Range* and so it is also termed as the *Semi Inter-Quartile Range* (Semi-IQR). Symbolically,

$$\text{Semi-IQR or } Q = \frac{\text{IQR}}{2} = \frac{Q_3 - Q_1}{2}$$

In a symmetrical distribution, the median lies halfway on the scale from Q_1 and Q_3. Therefore, the value $Q_1 + Q$ or $Q_3 - Q$ gives the value of the median. But, generally, distributions are not symmetrical and so $Q_1 + Q$ or $Q_3 - Q$ would not give the value of the median.

If the score density at the middle of the distribution is more, the Q will be small. If scores are widely scattered, Q will be large.

Q from Ungrouped Data

To find Q_1 and Q_3 from ordered data, one finds the points below which 25 per cent and 75 per cent of the scores lie. For example, if there are 20 total scores, Q_1 would be the point below which 5 (25% of 20) scores lie and Q_3 would be the point below which 15 (75% of 20) scores lie. Thus Q_1 would be half way between the 5th and 6th scores and Q_3 would be half way between the 15th and 16th scores.

Q From Grouped Data

(Data from Table 2)

C.I. Scores	Frequency f
10—14	3
15—19	58
20—24	9
25—29	18 35
30—34	11
35—39	5
40—44	
45—49	
50—54	
	1
	N=60

Calculations

For calculating Q_1 and Q_3 follow the same steps as for Median, except that $Q_1=1/4$ and $Q_3=3/4$ of the frequencies.

$$Q_1=l+\left(\frac{N/4-F}{f}\times i\right) \qquad Q_3=l+\left(\frac{3/4N-F}{f}\times i\right)$$

$$=19.5+\left(\frac{15-8}{9}\times 5\right) \qquad =29.5+\left(\frac{45-35}{11}\times 5\right)$$

$$=19.5+3.9 \qquad =29.5+4.55$$

$$=23.4 \qquad =34.05$$

$$Q=\frac{Q_3-Q_1}{2}=\frac{30.05-23.4}{2}=5.33$$

$N/4=15$

$3N/4=45$

Merits of Q

(*i*) It is a more representative and trustworthy measure of variability than the overall range ;

(*ii*) It is a good index of score density at the middle of the distribution ;

(*iii*) Quartiles are useful in indicating the skewness of a distribution ;

$Q_3-Mdn>Mdn-Q_1$ indicates +ve skewness

$Q_3-Mdn<Mdn-Q_1$ indicates −ve skewness

$Q_3-Mdn=Mdn-Q_1$ indicates zero skewness ;

(*iv*) Like the median, Q is applicable to open-end distributions.

Limitations of Q

(*i*) It is not capable for further algebraic treatment ;

(*ii*) It is possible for two distributions to have equal Qs but quite dissimilar variability of the lower and upper 25% of scores ;

(*iii*) It is affected to a considerable extent by fluctuations in sampling. A change in the value of a single item may, in certain cases, affect its value considerably.

Use a Quartile Deviation—

(*i*) When the median is a measure of a central tecdency ;

(*ii*) When the distribution is incomplete at either end ;

(*iii*) When there are scattered or extreme scores which would disproportionately influence the SD ;

(*iv*) When the concentration around the median—the middle 50% of cases—is of primary interest.

(C) Average Deviation (AD) or Mean Deviation (MD)

AD is the arithmetic mean of the deviations of all the scores in a series taken from their mean (occasionally from the median or mode).

In aggregating deviations, the algebraic sign are not taken into account.

AD From Ungrouped Data

Use the formula : $AD = \frac{\Sigma/x/}{N}$

where $x = X - M$ (X = a score in the series

M · = arithmetic Mean of the series)

$|x|$ indicates the absolute value of x, disregarding the algebraic signs.

Example

Scores : 6, 8, 10, 12, 15. Here, the mean is 10.

Deviations (x) : −4, −2, 0, 2, 4

$\Sigma/x/ = 12$

$$\therefore \quad AD = \frac{\Sigma/x/}{N} = \frac{12}{5} = 2.4$$

AD From Grouped Data

(Data from Table 2)

C.I. *Scores*	Midpoints X	Frequencies f	Deviations $x=X-M$	Product $f.x$
10–14	12	3	−17	−51
15–19	17	5	−12	−60
20–24	22	9	−7	−63
25–29	27	18	−2	−36
30–34	32	11	3	33
35–39	37	5	8	40
40–44	42	6	13	78
45–49	47	2	18	36
50–54	52	1	23	23
		N=60		420

Mean=29.0

$$\text{AD}=\frac{\Sigma|f.x|}{N}$$

$$=420/60$$

$$=7.0$$

In the normal distribution, the AD, when measured off on the scale above and below the mean, includes the middle 57.5% of the cases. The AD is, therefore, always somewhat larger than the Q, which includes the middle 50% of cases.

In the above table, we shall expect about 57.5% students to have their scores between the mean ± 1AD, *i.e.*, 29.0 ± 7.0, *i.e.*, between 22 and 36.

Merits of AD

(*i*) AD is readily understood. It is the average of the deviations from the mean ;

(*ii*) It is based on *all* the observations and, unlike Q or Range, it cannot be calculated in the absence of a single score ;

(*iii*) It is not affected very much by the values of the extreme items (even SD is affected by the values of extremes much more than the AD).

Limitations of AD

AD ignores the algebraic signs of the deviations and as such it is not capable of further mathematical treatment.

Use the AD—

(*i*) When it is desired to weigh all deviations from the mean according to their size ;

(*ii*) When extreme deviations would influence SD unduly.

(D) The Standard Deviation or SD

The SD is the most stable index of variability. It differs from the AD in several respects :

(*i*) In computing AD, we disregard signs, whereas in finding SD we avoid the difficulty of signs by squaring the separate deviations ;

(*ii*) The squared deviations used in computing SD are always taken from the mean, never from the median or the mode.

The conventional symbol for the SD is the Greek letter sigma (σ).

(*a*) SD From Ungrouped Data

Use the formula : $\text{SD}=\sqrt{\frac{\Sigma x^2}{N}}$ where $x=X-M$

Example

Scores : 6, 8, 10, 12, 14. Here, the mean=10.

Deviations (x) : $-4, -2, 0, 2, 4$

x^2 : 16, 4, 0, 4, 16

Σx^2 : 40

$$\therefore \quad \text{SD}=\sqrt{\frac{\Sigma x^2}{N}}=\sqrt{\frac{40}{5}}=2.83$$

(*b*) SD From Ungrouped Data (*Long Method*)

In the Table on page 268, add one more column of fx^2, *i.e.*, multiply x and fx in column 4 and 5 for each interval. Add the products. Use the formula :

$$\text{SD}=\sqrt{\frac{\Sigma fx^2}{N}}$$

(*c*) SD From Grouped Data (*Short-cut Method*) :

(Data from Table 2)

C.I. Scores	Frequencies f	Deviation x'	Product fx'	Product fx'^2	Calculations
10—14	3	—3	—9	27	correction $c = \frac{\Sigma fx'}{N}$
15—19	5	—2	—10	20	
20—24	9	—1	—9 (—28)	9	$= \frac{24}{60}$
25—29	18	0	0	0	
30—34	11	1	11	11	$= .4$
35—39	5	2	10	20	$\therefore\ c^2 = .16$
40—44	6	3	19	54	Use the formula :
45—49	2	4	8	32	SD =
50—54	1	5	5 (52)	25	
	N=60		$\Sigma fx' = 24$	$\Sigma fx'^2 = 198$	$i\sqrt{\frac{\Sigma fx'^2}{N} - c^2}$
					$= 5\sqrt{\frac{198}{60} - 16}$
					$= 5\sqrt{3.14}$
					$= 5\ (1.77) = 8.85$

Procedure

(*i*) Assume a value for the mean.

(*ii*) Lay off the deviations from the AM by intervals.

(*iii*) Find fx' by multiplying frequencies with deviations for each C.I. Add the products.

(*iv*) Find fx'^2 by multiplying x' with fx'. Add the products.

(*v*) Obtain the correction to the AM, and then square it.

(*vi*) Use the formula.

Effect Upon SD

(*i*) If each score in a series is increased or decreased by the same quantity, the mean increases or decreases by that quantity, but the SD remains unchanged.

(*ii*) If each score in a series is multiplied by a constant, both the mean and the SD are multiplied by that amount.

SD and the Spread of Observations

In a symmetrical (normal) distribution,

(*i*) Mean±1 SD covers about 67% (actually, 68.26%) of the scores.
Mean±2 SD covers about 95% (actually, 95.44%) of the scores.
Mean±3 SD covers about 99% (actually, 99.73%) of the scores.

(*ii*) In large samples (N=500), the Range is about 6 times the SD.
If N is about 100, the Range is about 5 times the SD.
If N is about 50, the Range is about 4.5 times the SD.
If N is about 20, the Range is about 3.7 times the SD.

Merits of SD

(*i*) SD is rigidly defined and its value is always definite.

(*ii*) It is based on *all* the observations of the data.

(*iii*) It is amenable to algebraic treatment and possesses many mathematical properties. This is why it is used in many advanced studies.

(*iv*) It is less affected by fluctuations in sampling than most other measures of variability.

Limitations of SD

(*i*) It is difficult to understand and interpret SD.

(*ii*) It gives more weight to extreme items and less to those which are near the mean, because the squares of the deviations, which are big in size, would be proportionately greater than the squares of those which are comparatively small.

Use the SD—

(*i*) When a measure, having the greatest stability and reliability, is sought ;

(*ii*) When extreme deviations should exercise a proportionally greater effect upon variability ;

(*iii*) When the coefficient of correlation and other statistics are subsequently to be computed ;

(*iv*) When the interpretations related to the normal probability curve are desired.

V. MEASURES OF RELATIONSHIP

If we have two sets of scores from the same group of students, it is often desirable to know the degree to which the scores are related. A teacher may be interested in the relationship between :

(*i*) The Mathematics test scores and the scores in other school subjects ;

(*ii*) The ability of a student to play a game and his scholastic achievement ;

(*iii*) His physical fitness and the scholastic achievement ;

(*iv*) His scholastic achievement and intelligence ;

(*v*) The shape of his head and intelligence ;

(*vi*) His speed in reading and ability for abstract thinking ;

(*vii*) His ability to memorise and chronological age ; and so on.

The relationship among abilities can be studied by the method of correlation. It is a method of summarising the relationship between two sets of data.

A coefficient of correlation is a single number indicating the *going togetherness* of two variables.

Nature of Relationships

(A) If the relative position of each student in a sample is exactly the same in one test as in the other, the relationship is perfect and positive and the coefficient of correlation is 1.00. Here, the two variables vary together in the same direction.

Other examples of a perfect positive relationship are :

(*i*) Relationship between the diameter and the circumference of a circle ;

(*ii*) Relationship between the temperature and the height of the mercury column in a thermometer ;

(*iii*) Relationship between speed and the distance covered in a fixed time.

(B) If the relative position of each student in a sample is exactly in the reverse order in one test as in the other, the relationship is perfect but negative and the coefficient of correlation is —1.00.

Here, the two variables vary together in the opposite direction. Other examples of a perfect negative relationship are :

(*i*) Relationship between the pressure and volume of a gas at a constant temperature ;

(*ii*) Relationship between the number of men doing a work and the time required to do it ;

(*iii*) Relationship between the selling price and loss, if the cost price is constant.

(C) If in two tests, there is no correspondence between the two sets of the scores achieved by students in a sample, there is no systematic relationship and the coefficient of correlation is zero.

Examples of zero relationship are :

(*i*) The diameter of a cylinder and its height ;

(*ii*) The number of pages in a book and the quality of the content ;

(*iii*) The height of a bottle and the price of the medicine it contains.

Degrees of Correlation

The coefficient of correlation varies from +1.00 (perfect positive) to −1.00 (perfect negative) through .00 (zero correlation). The extreme values and zero correlation are *rarely* obtained in behavioural sciences ; but high (such as .92, .80 —.75 etc.) and low (such as .25, −.15, .10 etc.) values are common. Positive coefficients range from .00 up to 1.00 and negative coefficients from −1.00 up to .00. Coefficients of −.20, −.50, −.80, or −.90 indicate increasing degrees of negative or inverse relationship, while coefficients of .20, .50, .80 or .90 indicate increasing degrees of positive relationship.

Examples of positive imperfect (varying degrees) relationship are :

(*i*) Intelligence test scores and academic achievement scores (High) ;

(*ii*) Mathematics test scores and Science test scores (High) ;

(*iii*) Height and weight (Moderate) ;

(*iv*) Grip of the hand and tapping (Low) ;

(*v*) Shape of the head and intelligence (Slight, near zero).

Examples of negative imperfect (varying degrees) relationship are :

(*i*) The price of a commodity and its availability (High) ;

(*ii*) Intelligence and suggestibility (High) ;

(*iii*) Absence from school and school achievement (Moderate) ;

(*iv*) The number of physical defects among boys and school progress (Low) ;

(*v*) Height versus sociability (Slight, near zero).

The Scattergrams

The concept of correlation may be visualised by using scattergrams. The scattergrams are two-way plots of scores. These

plots represent several selected degrees or relation. If all the plots fall on a straight line, the relation is *perfect* (positive or negative) ; if they are evenly spread over the scattergram, there is no relation between the variables. The closer the plots come to forming a straight line, the greater the relation exhibited. It may be noted that for positive relations, both sets of scores increase ; for negative relations, one set of scores increases, while the other set decreases.

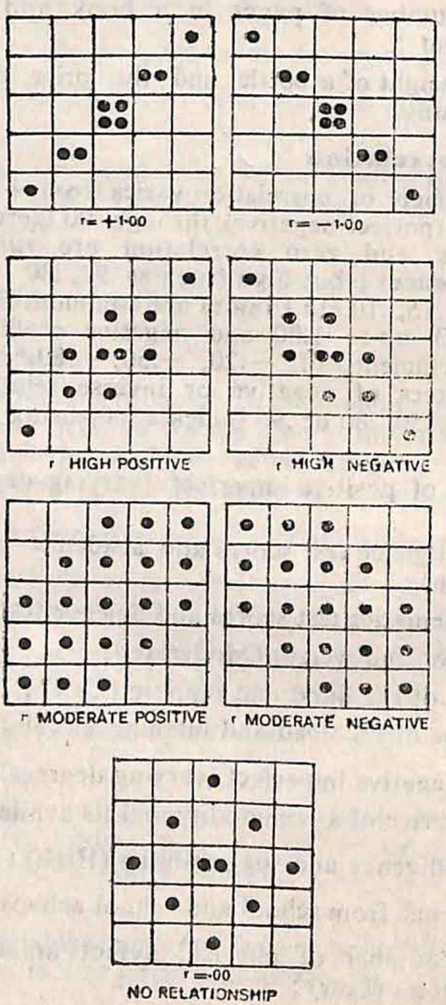


Fig. 4. Scattergrams indicating correlations of various sizes.

Interpreting the Correlation Coefficient

While interpreting the coefficient of correlation, the following points must be considered :

(*i*) Sign—the direction of relationship ;

(*ii*) Size or Magnitude—the degree or closeness of the relationship ;

(*iii*) Significance.

The positive sign indicates a direct relationship. It shows that there is a tendency for the two series (variables) to vary in the same direction. The negative sign indicates an inverse relationship. It shows that there is a tendency for the two series (variables) to vary in the opposite directions.

It is the size or magnitude and not the sign of the coefficient which gives us a clue to the closeness or degree of relationship. A zero coefficient indicates no consistent relationship whatsoever, while —.85 and .85 both indicate equally close relationship.

The coefficients of correlation are computed in order to determine whether there is *any* correlation (over and above chance relationship) between two variables and, if so, to determine the significance of the degree or closeness of relationship. Sometimes, .20 or —.30 may turn out to be very significant, while .70 or —.75 may turn out to be insignificant.

The following classification may be useful in interpreting a coefficient of correlation.

(*i*) r from .00 to $\pm$ .20 denotes an indifferent, negligible relationship ;

(*ii*) r from $\pm$ .20 to $\pm$ .40 denotes a definite but low, slight relationship ;

(*iii*) r from $\pm$ .40 to $\pm$ .70 denotes a substantial, marked relationship ;

(*iv*) r from $\pm$ .70 to $\pm$ .99 denotes a high to very high relationship ;

(*v*) r of $\pm$ 1.00 denotes a perfect relationship.

This classification is broad and tentative, and can only be accepted as a general guide with certain reservations. A correlation coefficient is always to be judged with reference to the conditions under which it is obtained and the objectives of the experiment.

In interpreting correlation coefficients two points should be borne in mind :

(*i*) They are not an indication of cause and effect. One may come across all sorts of variables that are related but have no causal relationship. For example, among children, the size of the big toe is slightly correlated with mental age ; yet one does not cause the other. They are correlated simply because they are both related to a third variable—*chronological age*.

(*ii*) The coefficient is a very complex function of the degree of relationship, and two coefficients cannot be directly compared. A given r should not be interpreted directly as a percentage.

An r of .45 does not mean 45% relationship. An r of .60 does not indicate twice the relationship that is indicated by r of .30. An increase in correlaion from $r=.50$ to .70 is not equivalent to an increase in $r=.20$ to .40.

Uses of Correlation Coefficient

(*i*) It is useful in validating a test ; *e.g.*, a group intelligence test.

(*ii*) It is useful in determining the reliability of a test.

(*iii*) It gives us an indication of the degree of the objectivity of a test.

(*iv*) It can answer the validity of arguments for or against a statement or a belief ; *e.g.*, Men are more intelligent than women.

(*v*) It indicates the nature of the relationship between two variables.

(*vi*) It predicts the value of one variable from another. We can often predict from a battery of aptitude tests the probable success of an individual who plans to enter a given trade or profession. Advice on such a basis is measurably better than subjective judgement.

(*vii*) A knowledge of it is helpful in educational and vocational guidance, prognosis, in the selection of workers in office or factory, and in educational decision-making.

Methods of Correlation

There are several methods of finding the coefficient of correlation between two series of measures. If the data exist in ranked (ordinal) form, it is easier to use the Spearman Rank-Difference Correlation Coefficient *rho* (ρ). In this method, if the data are in the form of raw scores, they are translated into rank order. Study the following example :

Table 3. Computation of ρ by Spearman-Rank Difference Method

Students	Marks in History X	Marks in Geography Y	Rank in History R_1	Rank in Geography R_2	$D=R_1-R_2$	D^2
A	72	62	6	7.5	−1.5	2.25
B	77	76	5	3	2	4.00
C	79	77	4	2	2	4.00
D	59	52	9.5	9	0.5	0.25
E	59	62	9.5	7.5	2	4.00
F	92	81	2	1	1	1.00
G	97	67	1	5	−4	16.00
H	68	44	7	10	−3	9.00
I	91	74	3	4	−1	1.00
J	60	65	8	6	2	4.00
N=10					$\Sigma D=0$	$\Sigma D^2=45.50$

$$\rho = 1-\frac{6\Sigma D^2}{N(N^2-1)} = 1-\frac{6\times 45.50}{10\,(100-1)} = 1-\frac{9.1}{33} = .724$$

Procedures

(*i*) Rank the individuals from the highest to the lowest in the first variable. If two or more students get the same score, give them the average rank, *e.g.*, the two individuals D and E get the same score of 59. Each is ranked 9.5 instead of ranking one of them 9 and the other 10. Call these as ranks R_1.

(*ii*) Similarly, rank the second variable and call them as R_2.

(*iii*) Find the difference between each pair of ranks. $D=R_1-R_2$. Check that the algebraic sum of D is always zero.

(*iv*) Square each D to find D^2. Sum up D^2 and apply the formula.

Interpretation

Scores in History and scores in Geography have high positive relationship, which indicates that students scoring high marks in the History test would also, generally, score high marks in the Geograph test.

Characteristics of Rho (ρ)

The size of the coefficient is directly affected by the size of the rank differences. If the ranks are the same for both tests, each rank difference will be zero and ultimately D^2 will be zero. This means that the correlation is perfect ; *i.e.*, 1.00. If the rank differences are very large, and the fraction is greater than one, then the correlation will be negative.

Advantages of Rank Difference Method

(*i*) ρ is much easier to compute than the coefficient of correlation (*r*) computed by the Pearson Product Moment Method.

(*ii*) It is quite easy to interpret ρ.

Limitations of Rank Difference Method

(*i*) When the interval data are converted into rank-ordered data the information about the size of the score differences is lost ; *e.g.*, in Table 3, if C gets scores in History from 78 up to 90, his rank remains only 4 ; and if D gets scores in Geography from 45 up to 61, his rank remains only 9.

(*ii*) If the number of cases are more, giving ranks to them becomes a tedious job.

VI. THE NORMAL PROBABILITY CURVE

Shapes of Data Distribution

Distribution of scores may assume many different shapes. When a frequency distribution is plotted with only a small number of scores, the shape of the curve will be very uneven or irregular. With a large number of scores, the curve would ordinarily be expected to take on a more smoothed or regular appearance. The shape of this smooth curve will depend upon (*i*) the properties of the measuring instrument, and (*ii*) the distribution of the underlying characteristic we are attempting to measure. The three types of curves (distributions) most frequently discussed in educational measurement are :

(*i*) Normal Probability Curve or Normal Curve ;

(*ii*) Positively Skewed Curves ; and

(*iii*) Negatively Skewed Curves.

The Normal Probability Curve

It is a bell-shaped perfectly bilaterally symmetrical curve wherein the measures are concentrated closed around the centre and taper off from this central high (crest) to the left and right. There are relatively few measures at the *low-score-end* of the scale ; an increasing number up to a maximum at the middle position ; and a progressive falling-off towards the *high-score-end* of the scale.

The Normal Probability Curve (NPC) or Normal Curve is typical of many biological, anthropometrical, psychological and physical measurements. It occurs whenever a large element of chance enters into a measurement and when each chance event has about 50-50 probability of occurring.

The following figure shows the NPC :

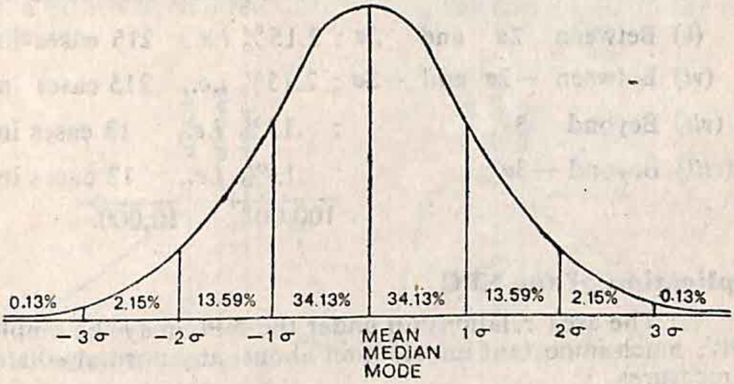


Fig. 5. The normal Probability curve.

Properties of NPC

(*i*) It is perfectly bilaterally symmetrical about the mean, the median and the mode ; *i.e.*, all these coincide exactly in the middle of the NPC.

(*ii*) From the maximum point at the mean of NPC, the height of the curve declines as we go in either direction from the mean. This falling-off is slow at first, then rapid and then slow again.

(*iii*) Theoretically, the curve never touches the base line. Its tails approach but never reach the base line. Hence the range is unlimited.

(*iv*) The points of inflection (the points where the curvature changes its direction) are each ± 1 SD from the mean ordinate.

(*v*) The height of the curve at a distance of 1 SD, 2 SD and 3 SD from the mean on both sides is 60.7%, 13.5% and 1.1% respectively of the height at the mean.

(*vi*) In a normal distribution, the mean equals the median exactly and the skewness is zero.

Areas Under the NPC

The distances, always in units of SD, are measured off on the base line of the normal curve from the mean as origin.

The number of cases in the normal distribution between the mean and the ordinate erected at the distances of $\pm 1\sigma$, $\pm 2\sigma$ and $\pm 3\sigma$ is shown below :

(*i*) Between mean and 1σ : 34.13% *i.e.*, 3413 cases in 10,000

(*ii*) Between mean and -1σ : 34.13 % *i.e.*, 3413 cases in 10,000

(*iii*) Between 16 and 2σ : 13.59% *i.e.*, 1359 cases in 10,000

(*iv*) Between -1σ and -2σ : 13.59% *i.e.*, 1359 cases in 10,000

(*v*) Between 2σ and 3σ : 2.15% *i.e.*, 215 cases in 10,000

(*vi*) Between -2σ and -3σ : 2.15% *i.e.*, 215 cases in 10,000

(*vii*) Beyond 3σ : .13% *i.e.*, 13 cases in 10,000

(*viii*) Beyond -3σ : .13% *i.e.*, 13 cases in 10,000

100.00% 10,000

Application of the NPC

(*i*) The area relationship under the NPC may be employed to derive much important information about any normal distribution of measures.

(*ii*) A given histogram or frequency polygon may be compared with an NPC of the same area, mean and SD.

(*iii*) The percentage of cases in a normal distribution within given limits can be determined.

(*iv*) The limits in any normal distribution, which include a given percentage of the cases, can be found out.

(*v*) Two distributions in terms of *overlapping* can be compared.

(*vi*) The relative difficulty of test questions, problems and other test items can be determined.

(*vii*) Using an NPC, a given group can be separated into sub-groups according to capacity, when the trait is normally distributed.

Skewness

A distribution is said to be skewed when—

(*i*) The mean and the median fall at different points in the distribution ;

(*ii*) The balance or centre of gravity is shifted to one side or the other.

When the dispersion or scatter of the scores in a series is greater on one side of the point of a central tendency than on the other, the distribution is skewed.

Positively Skewed Distribution

When most of the scores pile up at the *low end (or left)* of the distribution and spread out more gradually towards the *high end* of it, the distribution is said to be *positively skewed.*

In a positively skewed distribution, the mean falls to the right of the median.

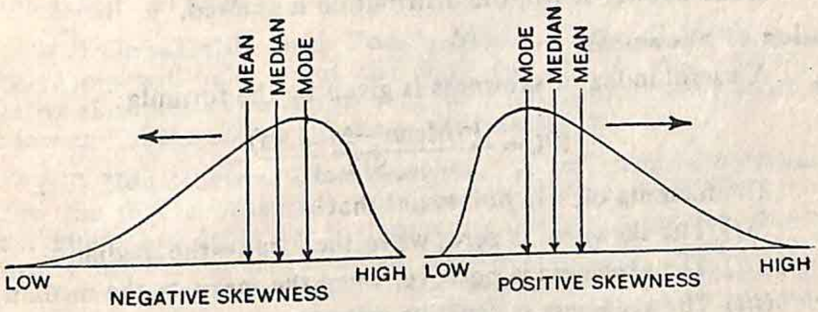


Fig. 6. Skewed Curves.

Negatively Skewed Distribution

When most of the scores pile up at the *high end (or right)* of the distribution, and spread out more gradually towards the *low end* of it, the distribution is said to be *negatively skewed.*

In a negatively skewed distribution, the mean falls to the left of the median.

Remember

In a skewed curve—

(*i*) The mean and the mode fall on opposite sides of the median ;

(*ii*) The mean is pulled more towards the skewed end of the distribution than is the median ;

(*iii*) The greater the gap between the mean and the median, the greater the skewness. The closer together are the mean and the median, the less is the skewness.

Dispersion and Skewness

Dispersion shows the deviation of scores from the mean or from the median. The SD or the Q fails to show the manner of deviation of the distribution. Skewness, on the other hand, shows the direction of deviation (asymmetry) and the position of the mean in relation to the median (or the mode). Skewness brings about a distortion in the curve.

Detection of Skewness

For detecting skewness, put one of the following questions to yourself :

(*i*) Do the mean, the median and the mode coincide ?

(*ii*) At points of equal deviations on either side of the mode, are the frequencies equal ?

If the answer is *No*, the distribution is skewed.

Index of Skewness

A useful index of skewness is given by the formula

$$SK = \frac{3\,(\text{Mean}-\text{Median})}{SD}$$

The formula clearly points out that—

(*i*) The skewness is zero, when the mean=the median ;

(*ii*) The skewness is positive, when the mean > the median ;

(*iii*) The skewness is negative when the mean < the median.

Kurtosis

The term *kurtosis* refers to the peakedness or flatness of a frequency distribution as compared with the normal.

A frequency distribution more peaked than the normal is said to be *leptokurtic*. A frequency distribution, which is flatter than the normal, is said to be *platykurtic*. A normal curve is also called *mesokurtic*. The following figure shows these three types plotted on the same diagram around the same mean.

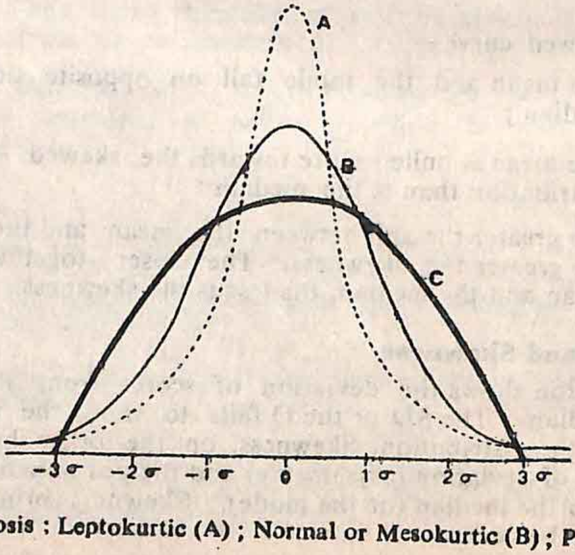


Fig. 7. Kurtosis ; Leptokurtic (A) ; Normal or Mesokurtic (B) ; Platykurtic (C).

Why Distributions Exhibit Skewness or Kurtosis

The reasons why distributions exhibit skewness and kurtosis are numerous and often complex. The common causes of asymmetry are :

(*i*) **Selection.** Biased selection produces skewness in the distribution of the scores ; *e.g.*, inadequate sampling, homogeneity of the group, an inadequately constructed and administered test, etc.

(*ii*) **Unsuitable and Poorly-Made Test.** If a test is too easy, scores will pile up at the high end of the scale, giving a negative skewness. If a test is very difficult, scores will pile up at the low end of the scale, giving a positive skewness.

(*iii*) **Non-Normal Distributions.** A real lack of normality in the trait that is measured, produces skewness and kurtosis ; *e.g.*, the likelihood of death due to degenerate diseases is greatest during maturity and old age and minimal during the early years of one's life. Teacher's salaries in a school, where most of the teachers are experienced and are close to the maximum on the salary schedule, will give a negative skewed distribution.

(*iv*) **Errors in the Use of Tests.** Errors in administering, scoring, etc., of a test tend to make a skewness in the distribution.

Other non-normal curves

The Bi-Modal Curve

When there are two distinct peaks in a distribution, a bimodal curve is obtained. This happens when there are two distinct groups in a class.

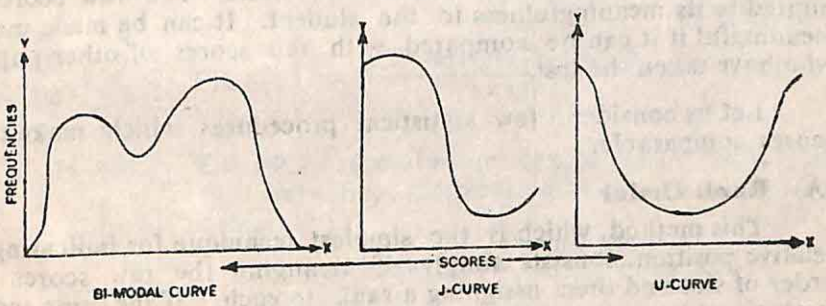


Fig. 8. Non-normal Curves.

The J-Shaped Curve

Such curves describe certain forms of social behaviour ; *e.g.*, tabulating the number of students who appear at a lecture *on time* and the number who arrive 5, 10 or 15^+ minutes late. J-curves are rarely encountered in mental and physical measurements.

The U-shaped Curve

Like J-curves, U-curves are rarely encountered in mental and physical measurements. They are sometimes found in the measurement of social and personality traits, if the test measures a trait that is likely to be present or absent in an *all-or-none-manner*.

VII. INTERPRETING RESULTS FROM TEACHER-MADE TESTS

If a teacher wants to obtain the maximum information from the results of any test, an item-by-item analysis should be done. But this is not feasible, for large classes are now found in most schools. Some simpler means of describing pupil performance must therefore be found. This generally takes the form of determining some one score that is assigned to each test paper.

Raw Score

Perhaps, the simplest and most used score is the raw score, representing the number of items answered correctly or, as in an essay-type examination, the number of points awarded by the scorer.

The lack of an absolute zero and the lack of equal units of measurement are general weaknesses of the measures produced by educational and psychological testing. These weaknesses contribute to making raw scores difficult to interpret and have led to the development of other types of scores that are somewhat more meaningful.

However, the real meaning of the score depends on how it compares with what other pupils have done. The raw score is limited in its meaningfulness to the student. It can be made more meaningful if it can be compared with the scores of other pupils who have taken the test.

Let us consider a few statistical procedures which make test scores comparable.

(A) Rank Order

This method, which is the simplest technique for indicating a relative position, consists simply of arranging the raw scores in order of size and then assigning a rank to each. If the same score is obtained by two or more pupils, the ranks are averaged.

Limitations

(*i*) If the number of scores is large, the process of ranking will become unwieldy ;

(*ii*) The same rank may have a different meaning in groups of different sizes ; *e.g.*, a rank of 10 in a group of 30 is not the same as the rank of 10 in a group of 150.

(B) Percentile Ranks

A percentile rank of a pupil, corresponding to a particular raw score, is a number that indicates the percentage of pupils scoring below him.

For computing the percentile rank of a given score in a frequency distribution, the following formula will be found useful :

$$\text{Percentile Rank PR} = \frac{iF + (\text{Raw score} - l)f}{iN} \times 100$$

where i=class interval ;

l=lower limit of the interval containing the raw score ;

f=frequency of the C.I. containing the raw score ;

F=the number of cases below the C.I containing the raw score ;

N=the total number of cases.

(Data from Table 2)

C.I. Scores	Frequency f	Calculation of PR of a Score
10−14	3	PR of 16 $= \frac{(5\times3)+(16-14.5)5}{5\times60}\times100=7.5$
15−19	5	
20−24	9	PR of 44 $= \frac{(5\times51)+(44-39.5)6}{5\times60}\times100=94$
25−29	18	
30−34	11	PR of 29.5 $= \frac{(5\times17)+(29.5-24.5)18}{5\times60}$
35−39	5	
40−44	6	$\times100=58.3$
45−49	2	PR of 37 $= \frac{(5\times46)+(37-34.5)5}{5\times60}\times100=80.8$
50−54	1	
	N=60	The PR of several scores can be read directly from the frequency distribution ; *e.g.*, 35 scores lie below 29.5 ∴ PR of 29.5 $= \frac{35\times100}{60}=58.3$ Again, 46+2.5 scores lie below the midpoint 37. ∴ PR of 37 $= \frac{48.5\times100}{60}=80.0$

We have already seen that the points that divide a distribution into 100 equal parts are called percentiles. The median is the 50th percentile, Q_1 is the 25th percentile, and Q_3 is the 75th percentile.

The percentile is a point on the score scale *below* which a given percentage of the cases lie. P_{10} is the point below which 10% of the scores lie, the 64th percentile (P_{64}) is the point below which lie 64% of the scores.

The method of calculating percentiles is essentially the same as that employed in finding the median. The formula is

$$P_p=l+\left(\frac{pN-F}{fp}\times\right)$$

where p =the percentage of the distribution wanted, *e.g.*, 10%, 45% ;

l =the exact lower limit of C.I. upon which P_p lies ;

pN=the part of N to be counted off in order to reach P_p :

F =the sum of all frequencies below l ;

fp =the frequency within the interval upon which P_p falls ;

i =the length of the C.I.

(Data from Table 2)

C.I. Scores	Frequency f		Calculation of Percentiles
10—14	3	3	10% of 60=6
15—19	5		$\therefore\ P_{10}=14.5+\left(\frac{6-3}{5}\times 5\right)=17.5$
20—24	9		
25—29	18	35	60% of 60=36
30—34	11		$\therefore\ P_{60}=29.5+\left(\frac{36-35}{11}\times 5\right)=29.95$
35—39	5		
40—44	6		*Remember*
45—49	2		$P_0=9.5$ (l of the first C.I.)
50—54	1		and $P_{100}=54.5$ (upper limit of the last C.I.)
	N=60		

Percentiles and PR

(*i*) A percentile is a *point* on the scale, whereas a PR represents an *area* lying between two adjacent percentiles.

(*ii*) In calculating percentiles, one *starts* with a certain per cent of N, while in calculating PR one begins with an individual score and then determines the percentage of the scores which lie below it.

Uses of Percentiles and PR

(*i*) When a pupil knows his PR, he knows immediately how well he has done in comparison with the other pupils in the group. PR is meaningful in and of itself.

(*ii*) It provides a relatively fair means for combining scores from different tests ; *e.g.*,

	Neela		*Meena*	
	Raw Score	*PR*	*Raw Score*	*PR*
Test I	23	95	16	40
Test II	50	45	80	96
Test III	40	57	38	49
	113	195	134	185

Here, even if Meena has a better (raw) score than Neela, Neela has the better performance than Meena, for her PR is better than that of Meena.

Characteristics of PR

(*i*) They present only a rank order of test results ;

(*ii*) A single raw-score-difference near the mean may produce a change of several PR points, while a relatively large raw-score-difference at the extremes of the distribution may produce a very small PR difference. Therefore, the PR differences near the middle of the distribution must be interpreted with care and caution ;

(*iii*) A PR indicates an individual's position in relation to the reference group, and is not a measure of growth.

Limitations of Percentiles and PR

(*i*) PR are less reliable than z-scores and T-scores, for they are more affected by minor irregularities in the distribution of scores ;

(*ii*) PR cannot, with strict validity, be averaged, added or subtracted.

(*iii*) The size of the percentile units is not constant in terms of raw score units. For example, if the distribution is normal, the raw score differences between the 90th and the 99th percentiles is much greater than the raw score difference between the 50th and the 59th percentiles. Thus, the differences in percentiles represent true differences at the extremes rather than at the middle of a normal distribution.

(*iv*) Percentiles are not well suited to the computation of means, correlations and other statistical measures.

(C) Standard Scores

One of the methods by which we can indicate a pupil's relative position in a group is to convert raw scores into standard scores. Basically, standard scores express test performance in terms of SD units from the mean. Out of many, we shall study two types of standard scores, *viz.*, z-scores and T-scores.

Z-Scores

The z-score is the basic form of the standard score and expresses the deviation of the raw score from the mean in terms of SD units. The formula for computing z-score is :

$$z = \frac{\text{raw score} - \text{mean}}{\text{standard deviation}} = \frac{X - M}{SD}$$

From the formula, it can be derived that

(*i*) if the raw score=mean, *z*-score is zero ;

(*ii*) if the raw score>mean, *z*-score is positive :

(*iii*) if the raw score<mean, *z*-score is negative.

Interpret Shakuntala's performance on the three tests given below :

	Raw score	*Mean*	*SD*	*z-score*	*T-score*
Mathematics	60	55	10.0	.5	55
Mother Tongue	48	50	5.0	—.4	46
Music	36	30	4.8	1.2	62

Interpretation : (*i*) Shakuntala is better in music, good in Mathematics and below average in the mother tognue, though the raw scores tell quite different story.

(*ii*) The raw scores of 80 in Mathematics, 63 (actually 62.5) in the mother tongue and 48 in music are equal since all are 2.5 units above the mean (*i.e.*, in all these cases, the *z*-score will be 2.5).

Advantages of z-Scores

(*i*) They permit us to convert raw scores into a common scale which has equal units and which can be readily interpreted.

(*ii*) They give us an idea of how well a teacher-made test is. A good teacher-made test designed to discriminate among students will generally have a range between 4 and 5 SDs, *i.e.*, 2.0 to 2.5 SDs on either side of the mean.

Limitation of z-scores

They involve the use of decimals and negative numbers.

T-Scores

In order to remove the limitation of *z*-scores, slightly modified standard scores, known as T-scores, are often used. These are obtained by multiplying a *z*-score by a constant 10 (to eliminate the decimals) and adding another constant 50 (large enough to eliminate all negative numbers). The formula for the T-score is :

$$T=10_{z}+50 \quad \text{where} \quad z=\frac{X-M}{SD}$$

There is no theoretical advantage for the T-score over the *z*-score or vice versa. In obtaining a T-score, the mean is set at 50 and the SD is taken as 10.

T-scores of 55, 67 and 72 mean the scores of .5, 1.7 and 2.2 SD above the mean. A *z*-score of—1.5 would be a T-score of 35.

Deviation IQs

Deviation IQs are standard scores with means of 100 and, depending on the test, with SDs usually (but not always) of 15. A student with an IQ of 70 has score of 2 SD below the mean and a student with an IQ 115. has a score of 1 SD above the mean.

Deviation IQs are used to remove inadequacies of IQ, which is the most misunderstood concept in measurement.

(D) Letter Grades

This method of letter grades gives the students immediate information about his relative position in a group. It is usually a crude approximation to PRs. For example, if the letters A, B, C, D and E are used, the highest scores are assigned a grade of A, the next highest group a grade of B, and so on. The letter grade is nowhere so exact as a PR ; but it does supply a little more information than a raw score. It also provides a somewhat fairer means of combining scores from several tests. The letter grades have the limitation that they are merely a crude interpretation of a raw score.

The use of PR is a much more exact procedure in that it gives us the relative position of every individual and does not merely place each person in one of the broad categories.

Some of the *purposes* which are served by grades, and which would not be served by merely reporting various test scores or the detailed results of other methods of evaluation, are :

(*i*) A grade provides a summarising appraisal. It gives us an over-all assessment of many procedures for evaluating achievement such as tests, oral recitation, observation of performance, written assignments, etc.

(*ii*) A grade provides the pupil with a subjective judgement that he seems to desire and that can be of great value to him.

(*iii*) A grade provides a simple summary for parents.

(*iv*) Grades can serve a motivational function.

How to Assign Grades

There is no entirely scientific and objective procedure for assigning grades. One of the methods, known as the *Dichotomous System* involves only two categories—Pass/Fail or Satisfactory/Unsatisfactory. This system is highly subjective and based upon casual observation ; and such judgement is highly susceptible to error.

Teachers can use procedures that are quite objective for making assessments of a pupil's achievement, such as PRs, Standard Scores, etc. To obtain them involves operations which are quite objective and mathematical. But when it becomes necessary for the teacher to decide how many pupils should receive A's or B's or E's he must make subjective judgements. The subjective judgement of the teacher is still a very big factor in determining the number of persons who receive the different grades.

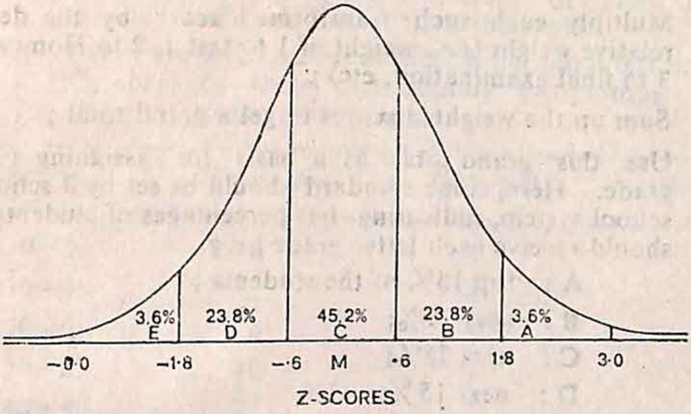
One of the popular and supposedly objective procedures for assigning grades is the so called *normal – curve method.* Some persons feel that this provides a highly scientific method which is independent of the teacher's judgement.

The basis of this procedure is the fact that many characteristics of human beings such as height, weight and measured IQs, if obtained for a large representative group of pupils of the same age, will show a normal distribution.

This method is based on a number of assumptions, such as :

(*i*) The scholastic achievement should be normally distributed ;

(*ii*) The letter grades should be assigned by dividing the range of test scores into five intervals of equal length and giving A to scores in the highest interval, B to the next highest and so on ;



Fig, 9. Five Letter Grades,

(*iii*) If the distribution of scores in a particular class is not normal, the reason for this is that the class group is only a sample from a larger group ;

(*iv*) The mean and the SD of the class group represent close approximations to the mean and SD of the larger theoretical group.

These assumptions involve about as many subjective judgements on the part of the teacher as does any other grading procedure. The teacher must use his judgement in constructing a test that he feels should produce a normal distribution of scores if given to a large group of pupils at this level. This assumption can never really be given an exact check. It is doubtful whether many teachers consistently produce tests that yield an approximately normal distribution. As a result, most teachers, using the normal curve method of grading, are probably using it with measures that are not distributed normally.

Even under ideal conditions, the normal curve method is not the objective and scientific procedure for assigning grades that some assume it to be.

Procedure for Assigning Grades

Grading will always call for certain arbitrary and subjective decisions. However, in grading the teacher should employ as much objective data as he can obtain and make use of certain mathematical procedure. For this purpose, the following method is suggested :

(*a*) Record the results of all methods of evaluation on a numerical basis :

(*b*) Transform these measures into PRs or *z*-scores.

(*c*) Multiply each such transformed score by the desired relative weight (*i.e.*, weight of 1 to test 1, 2 to Homework, 3 to final examination, etc) ;

(*d*) Sum up the weighted scores to get a grand total ;

(*e*) Use this grand total as a basis for assigning a letter grade. Here, some standard should be set by a school or school system, indicating the percentages of students that should receive each letter grade ; *e.g.*,

A : top 15% of the students ;
B : next 25%;
C : next 35%;
D : next 15 %;
E : bottom 10%,

Evaluate Yourself

1. Explain the terms : Sample, Statistics, Population, Ratio Scale, Interval Scale.
2. Give five examples each of a continuous series and of a discrete series.
3. Give the meaning of the following test scores in the continuous scores ; 30, 44, 72, 85, 96.
4. In each of the following distributions, indicate (*i*) the size, (*ii*) the midpoint, and (*iii*) the theoretical limits of intervals.

(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*g*)
0— 4	11—12	76—81	51—58	81—83	0— 9	24—30
5— 9	13—14	70—75	43—50	78—80	10--19	51—37
10—14	15—16	64—69	35—42	75—77	20—29	38—44

5. Tabulate the following scores into frequency distribution ;

83, 72, 53, 35, 39, 53, 17, 19, 64, 24,
42, 31, 45, 77, 76, 89, 70, 58, 68, 86,
50, 34, 64, 42, 21, 71, 29, 93, 45, 88,
82, 75, 40, 31, 59, 61, 34, 66, 95, 49,
54, 93, 36, 55, 49, 63, 83, 55, 47, 92,

(*i*) Draw the histogram of the series ;

(*ii*) Draw the frequency polygon of the frequency distribution. On the same graph, plot the smoothed frequency polygon ;

(*iii*) Find the mean (M). the median (Mdn), the mode, the quartile deviation (Q), the average deviation (AD), and the standard deviation (SD), of the series.

6. Below are given scores of three groups in a test in Physics. Compare the three distributions by plotting frequency polygons on the same graph :

Scores	Group A	Group B	Group C
0—9	0	4	8
10—19	2	4	7
20—29	4	5	8
30—39	10	6	9
40—49	20	7	10
50—59	15	12	5
60—69	6	8	5
70—79	3	7	3
80—89	0	7	5
	N=60	N=60	N=60

7. For each of the distributions given in question 6, find (*i*) M, Mdn and Mode, (*ii*) Q_1, Q_3 and Q ; (*iii*) AD and SD.

8. What are the limitations and advantages of a frequency distribution ? State the advantages of a graphic representation of the frequency distribution. What are the limitations of a histogram ?

9. In what way does the frequency polygon differ from the histogram ? Bring out as many points of difference as you can.

10. Why should the frequency polygon be smoothed ?

11. Mention the merits and limitations of (*i*) the mean, (*ii*) the median, (*iii*) the mode, (*iv*) the range, (*v*) the quartile deviation, (*vi*) the average deviation, (*vii*) the standard deviation.

12. Under what circumstances should we use the following :
(*i*) M ; (*ii*) Mdn ; (*iii*) Mode ; (*iv*) Range ;
(*v*) Q ; (*vi*) AD ; (*vii*) SD ?

13. For each of the distributions given below, find
(*i*) M, Mdn, and Mode ; (*ii*) Q_1, Q_3 and Q; (*iii*) AD and SD.
(*iv*) Explain Quartile or percentile.

(a)

Scores	*f*
56-58	2
53-55	3
50-52	4
47-49	6
44-46	5
	N=20

(b)

Scores	*f*
23-25	5
26-28	3
29-31	6
32-34	7
35-37	8
38-40	10
41-43	3
44-46	1
47-49	0
50-52	2
	N=45

(c)

Scores	*f*
15-24	4
25-34	5
35-44	5
45-54	9
55-64	8
65-74	5
75-84	7
85-94	6
	N=50

(d)

Scores	*f*
140-144	1
145-149	2
150-154	4
155-159	5
160-164	8
165-169	10
170-174	6
175-179	4
180-184	4
185-189	2
190-194	3
195-199	1
	N=50

(e)

Scores	*f*
16-19	1
20-23	0
24-27	5
28-31	10
32-35	20
36-39	12
40-43	7
44-47	3
48-51	4
52-55	3
	N=65

(f)

Scores	*f*
16-23	1
24-31	3
32-39	6
40-47	15
48-45	25
56-63	20
64-71	10
72-79	12
80-87	8
	N=100

(g)

Scores	*f*
104-107	3
108-111	5
112-115	16
116-119	24
120-123	52
124-127	50
128-131	25
132-135	16
136-139	9
	N=200

(h)

Scores	*f*
40—59	25
60—79	50
80—99	100
100-119	400
120-139	150
140-159	75
160-179	50
180-199	10
	N=860

14. A test in Chemistry was administered to 5 classes. The data collected are as under :

Class	*Mean*	*Number of Students (N)*
A	35	25
B	44.5	30
C	40	25
D	25.5	40
E	48	30

Find the mean for the whole group.

15. Ten students got the following scores in Biology ;
    56, 50, 45, 52, 74, 35, 20, 64, 72, 10.
    (*a*) Find the mean and the SD ;
    (*b*) Add 6 to each score and recalculate M and SD ;
    (*c*) Subtract 10 from each score and recalculate M and SD.
    (*d*) Multiply each score by 3 and compute M and SD.
    Draw the conclusions in each case.

16. Find an approximation to the true mode if—
    (*i*) M=61. Mdn=50 ; (*ii*) M=24, Mdn=24 ;
    (*iii*) M=20, Mdn=16.

17. Draw scattergrams to show the following correlations :
    (*a*) Perfect Positive, (*b*) Perfect Negative, (*c*) High Positive, (*d*) High Negative, (*e*) Moderate Positive, (*f*) Moderate Negative, (*g*) No Relationship.

18. Which points will you consider while interpreting the correlation coefficient ?

19. What are the uses of the correlation coefficient ?

20. Using the Spearman Rank Difference Method, find the coefficient of correlation in each of the following cases, and interpret the result in each case.

Students	Marks Test-X	Marks Test-Y	Marks Ability X	Marks Ability Y	Marks Test P	Marks Test Q	Rank Debate	Rank Drama
A	45	50	30	40	10	9	4	1
B	54	51	28	20	12	9	6.5	10
C	55	56	35	15	8	3	4	3
D	58	55	40	40	7	7	3	4.5
E	32	35	12	22	20	15	1	9
F	48	28	25	36	21	16	6.5	2
G	64	40	28	12	24	17	2	6
H	32	56	24	15	17	21	9	4.5
I	40	35	18	30	18	24	10	7
J	50	45	20	18	21	22	58	8

21. What are the advantages and limitations of the Rank Difference Method ?

22. Compute the percentiles P_{10}, P_{15}, P_{25} P_{40}, P_{60}, P_{75}, and P_{90} for each of the distributions given in Q. 13 (a) through (f),
23. What are the properties of a normal probability curve ?
24. Mention the various applications of the NPC.
25. When can a distribution be said to be
    (*a*) Skewed ? (*b*) Positively Skewed ? (*c*) Negatively Skewed ?
26. Draw a graph in each case, indieating the positions of the mean, the median and the mode in positively skewed and negatively skewed graphs ?
27. What is kurtosis ?
28. Why do distributions exhibit skewness or kurtosis ?
29. Refer to the distributions given in Question 13 and find the following PRs :
    (*a*) PRs of 48 and 55 [Q.13 (*a*)];
    (*b*) PRs of 46, 32 and 27 [Q.13 (*b*)];
    (*c*) PRs of 80 and 40 [Q.13(*c*)]
    (*d*) PRs of 150, 162 194 [Q.13(*d*)];
    (*e*) PRs of 53, 39 and 21 [Q.13(*e*)];
    (*f*) PRs of 25, 40 and 84 [Q.13(*f*)].
30. What are the charaeteristics of percentile ranks ?
31. Mention the limitations of percentiles and PRs.
22. Find the *z*- score and T-score in each of the following
    (*a*) score 48, M = 51, SD = 8;
    (*b*) score 40, M = 36, SD = 6.5;
    (*c*) score 12, M = 12, SD = 5.72;
    (*d*) score 85, M = 75, SD = 10.5.
33. What are the advantages and limitations of *z*-scores ?
34. Bring out the importance of letter grades in evaluation.
35. Answer the following questions :
    (*i*) In what way does the size of class intervals affect a frequency table ?
    (*ii*) In what respect is the median better than the mean as a measure of a central tendency ?
    (*iii*) Why is there a slight difference in the value of the mean computed from the same grouped and ungrouped data ?
    (*iv*) If two groups have the same mean in a test in History, are the groups identical in the achievement in History ? If so, why ?

(*v*) How do Q, Q, and Q help us in determining the skewness of a distribution ?

(*vi*) How do the mean the median help us in detecting skewness ?

(*vii*) What is the difference between a homogeneous and a heterogeneous group in statistics ?

(*viii*) It is possible that a score in a distribution may fall at a distance greater than 2Q from the median. Explain.

(*ix*) For two groups, the median is 32.5 and 30.5 respectively. Would the median of the combined group be 63.03 ? If so, why ?

(*x*) The Q for two groups is 8.0 and 7.5 respectively. Would the Q of the combined group be 15.5 ? If so, why ?

(*xi*) How does the variability of a distribution tell us more about a group than does the average value ?

(*xii*) What correlation would you anticipate in each of the following pairs of variables :

(*a*) Successful graduates every year and the extent of unemployment ;

(*b*) Salaries and qualifications of teachers;

(*c*) Ability of abstract thinking and intelligence :

(*d*) Area of the square and the measure of its sides ;

(*e*) Gravitational force and the distance from the earth-centre ?

(*xiii*) What precautions should be taken while interpreting the correlation coefficient ?

(*xiv*) Does an r of $+ .90$ show closer relationship than an r of $- .90$? Why ?

(*xv*) Is the value of $r = .85$ necessarily high in all the situations ? Explain.

(*xvi*) Does a percentile of zero correspond to a score of zero ? Give reason.

(*xvii*) What explanation will you offer for each of the following statements :

(*a*) Kishan has a PR of 88 in a test in Music;

(*b*) Manish has a PR of 50 in a test in Drawing;

(*c*) The P_{60} in a test in Science is 45 ?

(*xviii*) How does the difficulty value of a test affect its skewness ?

(*xix*) Why are *z*-scores and T-scores considered basically the same ?

(*xx*) What method would you suggest for assigning letter grades ?

36. Illustrate the meaning of 'central tendency' and 'viability'.

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